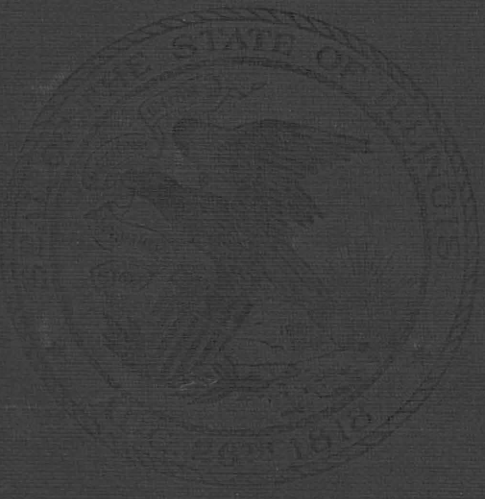

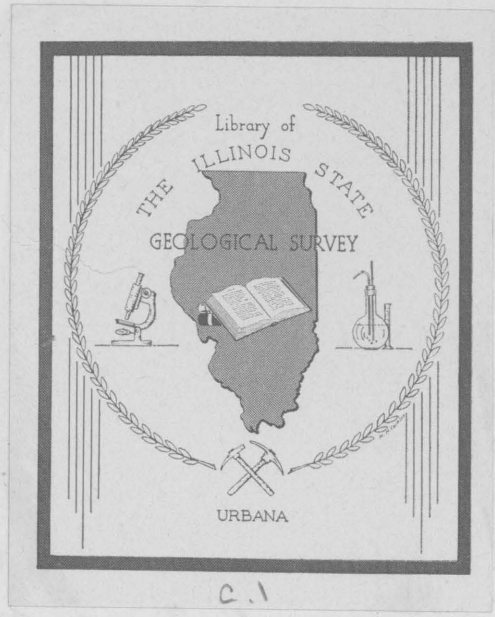

ERRATA.

Page 16, ¶ 2, line 7, read "mechanical" instead of "chemical".

Page 25, ¶ 5, line 3, read "1 to 6 feet" instead of "100 to 600 feet".

Page 123, Well No. 41, last line of introductory paragraph, read "1450 feet" instead of "450 feet".

STATE OF ILLINOIS
STATE GEOLOGICAL SURVEY
FRANK W. DeWOLF, DIRECTOR

BULLETIN NO. 24

Some Deep Borings in Illinois

BY

J. A. UDDEN

Work done in cooperation
with U. S. Geological Survey

State Geological Survey
University of Illinois
Urbana
1914

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LETTER OF TRANSMITTAL.

STATE GEOLOGICAL SURVEY,
UNIVERSITY OF ILLINOIS, JULY 30, 1914.

Governor E. F. Dunne, Chairman, and Members of the Geological Commission.

GENTLEMEN: I submit herewith a report on "Some Deep Borings in Illinois," and recommend that it be published as Bulletin No. 24.

The author, Dr. J. A. Udden, formerly of Augustana College Illinois was for several years a geologist in the Survey, during which time he was in charge of the study of borings, with special reference to the identification of formations penetrated, and to water resources. The patient and painstaking examination and interpretation of well samples and records by Dr. Udden are highly successful and mark him as a leader in such scientific work in the United States. Our knowledge of the underlying stratigraphy and mineral resources of Illinois is greatly extended by this report.

Very respectfully,

FRANK W. DEWOLF,
Director.

SOME DEEP BORINGS IN ILLINOIS.

By J. A. Udden.

PART I.—PURPOSES AND METHODS OF STUDY.

General Considerations.

PURPOSE OF THE REPORT.

During the years 1908 to 1911, while the writer was engaged as geologist on the Illinois State Geological Survey, and as special agent of the U. S. Geological Survey, he had occasion to examine a number of samples of cuttings from deep wells made in various parts of the State, for the purpose of more closely delimiting the underground formations. The U. S. Geological Survey cooperated actively in support of the investigations. It is proposed here to present a brief report of this work.

NEED OF MORE WORK ON WELL RECORDS.

The study of samples taken from deep explorations has long been an important part of the work of geologists everywhere. In the publications of the Worthen Survey of Illinois several hundred deep-well records were recorded. In the reports of the present Geological Survey of Iowa nearly an entire volume has been devoted to the publication and correlation of deep-well records. Professor Norton of this survey stands foremost among geologists in the Upper Mississippi Valley as a student of well samples and as an interpreter and correlator of deep-well sections. The region over which his investigations of this kind extend covers the entire State of Iowa and overlaps on all the adjacent territory. Several members of the United States Geological Survey have also given much attention to studies of this kind, notably Darton, Leverett, Mendenhall, Fuller, Harris, Gould, and Vaughan. Nevertheless, it appears to the present writer that the American geologists of late years have fallen far behind in obtaining and preserving underground data which are multiplying rapidly.

The increase in this kind of information which can now be obtained is due to several causes. The perfection in the art of drilling is continually reducing the cost of such work and makes drilling for any purpose more profitable than it was a few decades ago. The constantly growing population in the Mississippi Valley has caused an increase in

the demand for potable and mineral waters and a constant search for new deposits of oil, gas, and salt. Moreover, the general sinking of the water table, which has come with the deforestation and cultivation of the land, has made it necessary to find deeper and more lasting supplies of water for the general use of cities, railroads, manufacturers, and farmers. To obtain the record of deep borings that are constantly being made in every state would give employment to a large force of men.

RELATIVE IMPORTANCE OF WELL WORK.

Considering the fact that so much of the information which is obtained from the study of deep explorations cannot be obtained elsewhere, field work for obtaining such data cannot be regarded as expensive, since the records of a single well, if correctly interpreted, may frequently offer more really valuable geological information than can be obtained by the detailed and accurate mapping of the surface geology of an entire county. This statement is true for regions where the formations lie flat and where the relief is small, and such conditions are general over most of the great area between the Appalachians and the Rocky Mountains.

DRILLERS' LOGS.

There is perhaps some excuse for the geologists' neglect of the study of deep borings, in that many records kept by the drillers are somewhat unreliable, or at least difficult to interpret correctly. It is therefore important that an attempt should be made to obtain samples of drillings and to make a thorough examination of all such material. Realizing the importance of such work in this State, the Director of the Illinois State Geological Survey early made arrangements with the drillers and owners of wells to procure sets of samples of the material penetrated by their explorations. During the last three years that the present writer was in the service of this Survey, most of this material was examined by him. Excepting the Reed well in Bureau County, all the deep explorations reported in this paper have been examined and described from samples of rock material. The drillers' logs of the explored formations are sometimes recorded in current publications. More frequently they are preserved in old files of various business houses or of private parties. The necessity of prompt preservation of such records is sometimes, but not always, particularly urgent, in order that the information that they contain shall be preserved for all time.

SAMPLES.

If samples are not taken while wells are being drilled, the opportunity for collecting them is lost forever. In the earlier days samples were more often taken by owners of the wells than is customary today. Drilling is less of a novelty in our time. A few old well samples have been kept for many years, and it proved quite profitable to re-examine some of them. The record of the Monmouth well, which was published by Dr. Worthen from an examination of the samples made by Professor J. H. Southwell, is one of these. Devonian shale and limestone 109 feet thick and Kinderhook shale 124 feet thick were reported from this well without any descriptive particulars. On re-examination of the shales in these samples, which had been preserved for twenty-five years, they were found to contain *Sporangites huronense,* which undoubtedly correlates them with the Sweetland Creek shale in Iowa. The stratigraphic position of this shale is still a problem. It is evidently much more desirable to know the biological or physical characteristics of a shale or other rock, than to know that a shale or limestone exists at a given depth.

DESCRIPTIVE RECORDS AND INTERPRETED RECORDS.

Among the earlier geologists it was the common practice to give determinations of different strata reported from a well to the neglect of descriptions of their characteristics. For men with extensive training and experience this practice may be excusable, but with the progress of science it will certainly always be more desirable to find the determinations accompanied by full descriptions. For men of limited experience the practice of giving determinations alone is very objectionable, as such reports may involve errors which cannot be corrected. Determinations of this kind are also likely to be misunderstood by drillers and by the general public.

In the collection of well records from the northern part of the State the writer has found several logs that enumerated two or three St. Peter sands, one following the other several hundred feet apart. The driller had evidently used the name as a term describing a certain quality of sand, and not as the name of a certain well-defined formation.

TAKING OF SAMPLES.

In collecting samples for examination it is of course desirable to take them at as close intervals as possible. Large samples are not necessary. An ounce of cuttings taken from each bucket, or from every five feet of drilling, will be ample for the study of "Coal Measures"

strata in this State. Where the well is passing through the thicker limestones of the Silurian or Ordovician an ounce of cuttings taken every 10 feet is quite sufficient. When drilling in shale the operators are quite likely to neglect taking samples, owing to the desirability of rapidly penetrating such formations to avoid trouble from caving. In several sets which have been examined for this paper full samples were taken from the limestones, but only two or three samples represent a hundred feet of shale. In making records from samples this inconsistency must be considered. It is always well to procure the driller's record and to compare this with the result obtained from the samples. In some instances at least, it appears that the driller's record is more accurate in reporting measurements than the labels accompanying the samples, when both of them are not in full agreement.

In the driller's records published in this paper, scrupulous care has been taken to give the record in the words of the form in which it was originally prepared. This is true of the labels accompanying samples as well. When labels and records disagree note has been made of the fact. Future explorations may help to determine which of the two is correct.

SIGNIFICANCE OF MIXING IN SAMPLES.

Many samples represent more than one kind of rock. In drilling through heavy limestone or other rock of uniform character the driller collects the most representative samples. In going through the strata of limited thicknesses samples will be mixtures of more than one formation. In such samples the lowest rock is usually preserved in the greatest abundance and in the largest fragments. Rock which has been penetrated in the lower five or ten feet will make up the large part of the sample. Under such conditions the sequence of the strata may usually be determined by observing the size of the cuttings. The rock belonging to the upper formation, provided it is of somewhat nearly the same texture and toughness as that in the lower formation, will be more abundantly represented among the smaller fragments. In case of differences in hardness of the strata the representation among the several sizes of fragments may not have the same significance. Fragments of hard rock, when mixed with fragments of soft shale, will not grind fine as rapidly as when mixed with fragments of some other hard rock. Limestone, when overlying shale, will endure the wear of the shale under the drill for considerable distance, even 20 or 30 feet.

For the purpose of obtaining more precise information on the distance below its true position at which a rock may be found in the drillings, some of the records which follow have been closely examined.

Among twenty cases where coal has been seen in samples in which it evidently did not belong, it appears that in one case it had come from a seam 4 feet above the point at which the sample was taken; in six cases, 5 feet above it; in two cases, 6 feet; in three cases, 7 feet; in one case, 8 feet; in four cases, 10 feet; in two cases, 12 feet; and in one case, 26 feet above its position in the sample.

Limestone appears to last somewhat longer. Under certain conditions fragments of this rock may be found in samples taken at much greater distances below the stratum where they belong. This is particularly true when the drill passes through cavernous formations. In the well made at the State Asylum at Kankakee, fragments of Niagara limestone continued to appear in the drillings for several hundred feet below the bottom of the Niagara. Almost invariably the pieces of rock which fall into the bucket from above appear in the samples as a few fragments of considerable size, which have evidently been torn loose from caverns which were entered by the drill. Pebbles from the drift have often been observed in the drillings from 20 to 40 feet below the base of the drift. For making correct deductions with regard to the true position of material it is necessary to note to what depth a well has been cased, and at what stage in the work the casing has been installed.

PREPARATION OF SAMPLES.

It is always desirable that the samples be taken from the unwashed material directly from the bucket. When samples are washed some ingredients may be almost entirely removed. Samples may have the appearance of coming from a limestone, whereas the deposits they represent may be marls or clayey sands. In some samples the finest ingredient may contain characteristic materials which are important to note.

CARE OF SAMPLES.

For keeping and shipping samples bags of light cloth are very suitable. The United States Geological Survey uses this kind of sample bags, a four- by five-inch size being very serviceable. For samples which were obtained for this report from the Ohio Oil Company sample bags of manilla paper were used. These containers were furnished by the State Geological Survey and were provided with a metal strip at the top for closing. They were convenient to handle, but a few samples had been put in wet and the bags were torn and contents lost.

EXAMINATION OF SAMPLES.

A mere inspection will usually show whether samples consist of shale, limestone, or sandstone. If the sample is shale, the acid test may be applied to it to determine whether it is marly or calcareous, for which purpose a ten-per cent solution of hydrochloric acid will be found most suitable. Sometimes, however, the acid test is deceptive, for the sample may consist of fragments of clay or shale perfectly free from calcium carbonate, but mixed with calcareous material derived from limestone. Such a sample must be crushed in a mortar, and washed clean in order to free the shale fragments from the finest ground materials. It should then be examined under a hand lens while wet and again tested with acid for calcareous material. Samples consisting of limestone fragments should be treated in the same way. The texture of the rock will always appear best on a wet surface.

In limestones as well as in shales it is always desirable to look for fossils. The experience of the writer has been that for this purpose it is necessary to dry the samples after washing and then to separate the smaller fragments from the larger ones by means of a set of sieves. The writer has used a set of the same kind as the set used by the United States Department of Agriculture for separating gravels, sands, and silts in making chemical analysis of soils. Fossils, such as impressions of leaves, thin shells of molluscs, shells of foraminifera, and spores of plants, will often be found in shales upon splitting the larger fragments with a knife. Larger fossil fragments may readily be found among the larger fragments of the samples by mere inspection with the naked eye. In making close search for any particular fossils it has been found advantageous to examine the separate sizes of rock fragments spread on a black surface, such as black oil-cloth, on which sufficient water is poured to wet them entirely. The material is then spread out with a knife blade and arranged with the same instrument in ridges running in parallel directions. In this way the eye with the aid of the hand lens can follow each row of fragments and see each separate particle thus displayed. For work in obscure or rare fossils it has been found that different degrees of success in finding them is determined by differences in the amount of daylight available.

When examining samples it is desirable to take note of every possible characteristic of the rock, such as cleavage, texture, richness in organic fragments, toughness or brittleness. Notes should be made also of the occurrence of particles which are foreign in limestone, such as quartz grains of unusual color, grains of pyrite, or particles of bituminous materials. Determinations of the contents of shales and

limestones can be made by placing a part of the sample in a closed tube and noting changes of color, odor of fumes, behavior of the materials with a magnet after ignition, and other characteristics. Quartz grains imbedded in limestone can frequently be detected by grinding down a fragment of the rock on a stone, polishing the ground surface on a fine hone, and examining it for clear reflections from the polished surfaces of the sand grains. The light will be reflected from bright spots in the dull matrix of the limestone. Dolomitic limestone can be recognized by the crystallization, which results in a granular structure that is easily seen in a microscopic section, readily prepared from a small fragment, and by the slow effervescence in cold, dilute, hydrochloric acid. The fine material which is removed by washing a shale or a clay should be examined microscopically.

Sandstones should be examined with regard to sizes of grains in the mixtures. The most ready and most useful method of doing this is to make a mechanical analysis by the aid of a set of sieves, weighing the ingredients retained by each mesh, and expressing the result in ratios of their weight to that of the whole sample. It is also profitable to note the shapes of the grains and the character of their surfaces—whether angular or round, whether smooth or etched, and whether or not they have secondary crystalline faces. The mineral composition of the sand or gravel can usually be determined with greater or less accuracy and expressed in general terms or by percentages obtained by actual count of the grains of different kinds. Sandstones show various cementing materials such as carbonate of lime, silica, oxide of iron, and sulphide.

CARE OF FOSSILS AND OTHER RARE MATERIALS.

In the examination of any well samples specimens of fossils and rare characteristic minerals or rocks are occasionally found. These should be carefully preserved. It is, of course, desirable to retain subsamples of everything. But some specimens need to be submitted to specialists, and should be preserved for all time. Samples of this kind may be donated to some large museum, willing to care for them.

ADEQUATE FREEDOM IN THE DESCRIPTION OF SAMPLES.

In the descriptions which follow, everything has been sacrificed for fullness of detail and accuracy, and repetitions are the rule. Only in a few places where no differences in successive samples could be noted, the expression "like the preceding" has been used. It is believed, however, that the use of this phrase is contributive to negligence in

making observations. The range of observation is at best extremely limited in all work of this kind, and every possible detail of difference which can be made out may be helpful in the correct interpretation of the record, if not now, perhaps in the future, by some other worker. In obtaining records from drillers and in giving instruction for the taking of such records, it may be well to simplify matters by requiring descriptions to be made according to some set order, such as first naming of the rock, next stating its color, then describing the qualities pertaining to its hardness, and any other notable characteristics. But in making full and detailed descriptions of the material present in any sample this method imposes restrictions whch are objectionable. In the descriptions which follow but little regard has been given to the order of statement. The most abundant ingredient in any mixed sample has, however, always been described first.

Directions for Examination of Well Samples.

For workers who are interested in the study of well samples, a brief sketch of the methods used in obtaning the data presented in this paper is given in the form of directions for making examinations of such materials and for recording such examinations.

The sample should first be examined by direct inspection and with a hand lens.

I. If sample consists of sand, sandstone, gravel, or conglomerate, note adherence, size, form, polish or etching of surfaces, and mineral characters of grains or pebbles.

1) Adherence is slight in soft sandstone, greater in hard. It may be due to the presence of a matrix or cementing material. Note nature of cementing material, whether abundant or scarce, whether calcareous, siliceous, ferruginous, etc. For this purpose it may be convenient to place a small fragment of the rock in a drop of dilute hydrochloric acid on a glass slide and examine without cover glass.

2) Size of grains is best determined by making a mechanical analysis, using the method of the United States Bureau of Soils down to grains one-eighth of a millimeter in diameter, and giving numerical expressions to quantities of the different grades.

3) Form of grains discloses whether the sand is much or little worn, and whether the grains have grown by secondary crystallization. The finer grains are invariably more angular than the coarser grains in the

same sand, owing to the lesser force of impact of the smaller grains, and their more effective cushioning by water.

4) The polish or etching of the surfaces of most sand grains is not conspicuous, and may be neglected, but it is sometimes an important characteristic.

5) The mineral composition of sand grains is important. Numerical estimates of the different ingredients are always desirable. Most of the descriptions of the mineral composition of sands found in geological literature are inexact.

II. If sample is not as above, test for calcareous material by the application of a cold ten-per cent solution of hydrocloric acid.

1) If there is no response to acid the sample is probably either argillite or gypsum. Determine mineral character and note texture, structure, color, mineral, and fossil contents. If necessary, first wash and then dry the sample. It must be remembered however that coarse dolomite will not respond to dilute acid, unless heated, or unless the material to be tested is pulverized.

a. Mechanical analyses of silts, shales, and clays are desirable, but often impracticable to make. Instead of such, describe in general terms, such as coarse, medium, fine or finest texture, supplying microscopic measurements of the bulk of the material when possible.

b. Note whether the fragments show stratification, lamination, or lack of such structures. Describe any variations of these structures when present.

c. Avoid exaggerations in describing colors.

d. For determining the mineral contents of shales, examine sample under microscope and make blowpipe tests. Note the nature of escaping fumes before and during ignition, and changes in color. Also note the behavior of the material with magnet after ignition.

e. Fossils should be sought in the larger fragments with a hand lens. Such fragments may be split edgewise with a knife, when no fossils appear on the surface. The finer fragments should be sorted by sieves and each grade examined under a microscope for minute fossils, such as foraminifera, bryozoa, denticles of

annelids, spores, spicules of sponges, small parts of brachiopods and gasteropods and many others. Look also for microscopic concretions.

2) If there is effervescence with acid, the sample may be pure argillite mixed in the well with calcareous slime; clay ironstone; calcareous argillite, or marl; argillaceous limestone; dolomite; calcareous limestone; or a mixture of these. If the sample is not clean, it should be washed and again dried, then separated by sieves into many different sizes, and again tested for calcareous material.

a. If the sample is a mixture, the ingredients will usually appear in unequal quantities in the different lots. Each ingredient should be separately examined.

b. Clay ironstone effervesces extremely slowly and becomes magnetic after ignition.

c. Marl treated in acid leaves a considerable insoluble residue.

d. Argillaceous limestone treated in acid leaves a small insoluble residue.

e. Dolomite effervesces slowly.

f. Calcareous limestone effervesces rapidly. In distinguishing between dolomite limestone and calcareous limestone care should be taken to apply the acid on a surface of a fresh fracture of the rock fragment. Dolomite, when powdered, effervesces rapidly, like calcite. A good way for making this test is to place a drop of the acid on a glass slide, and then to place a small fragment of the rock in this drop and examine under a hand lens. Marls and argillaceous limestones should be examined in the same manner as argillites. Dolomites seldom have fossils, except as moulds or casts in the larger fragments. Coarseness of the crystals should be noted in dolomites, either by examining the finer-grained lots under the microscope or by making a thin section from some large fragment. Calcareous limestones should be examined and described as to texture, sedimentary structure, color, and fossil and mineral contents. The procedure is the same as with argillites.

f[1]. Organic limestones.—If organic fragments are present, the limestone may be called organic. If

organic fragments are invested by a thin surrounding coating of calcareous material, the rock may be described as an organic and incipiently oolitic rock. Organic fragments should be described as to size, form, abundance, arrangement, etc. When the organic fragments constitute the greater part of the rock and consist mostly of one class of organisms, this organism determines the name of the rock, as encrinital limestone, fusulina limestone, shell breccia, coral limestone, etc.

f^2. Characteristic minerals in limestones.—Limestones containing grains of green glauconite are said to be glauconitic. Limestones or dolomites impregnated with bituminous material are said to be bituminous. Similar descriptive names may be used for any other mineral ingredients, as, for example, pyritiferous, gypsiferous limestones.

f^3. Texture and structure of limestones.—A limestone consisting of the finest calcareous material exhibiting no texture may be called compact. In some calcareous limestone the porous space has been filled with crystalline calcite. A limestone of somewhat open texture is porous. If the open spaces are large, the rock is cavernous. If the rock consists of distinct thin layers, it may be described as laminated.

f^4. Color in limestones.—As most colors in limestone are faint, care should be taken to avoid exaggerations in color descriptions. Some limestones exhibit uneven distribution of color throughout the mass, resulting in blotches or stains which merit notice and separate description.

f^5. Fossils in calcareous limestones and marls.—These rocks should always be examined for fossils. For the most careful work it will always be found necessary to separate the cuttings into lots of different sizes after washing and drying. These lots are then separately examined by the aid of a good hand lens. The cuttings should be spread on a black surface, barely covered with water, and separated into rows narrow enough to

be seen in the field of the hand lens. Sufficiently strong light is always desirable for this work.

Identification of Formations.

CRITERIA FOR IDENTIFICATION.

Interpretations of records must be made usually from the lithologic characteristics of the sediments penetrated. In the wells discussed in this paper only a few formations have been found to contain characteristic fossils in sufficient abundance to enable the writer to identify them. Where one or two such horizons can be identified the remaining part of the section may frequently be made out. Correct determinations of the formations penetrated can be made in many cases without fossils, especially in localities where the terranes are fairly well known from other borings. For the greater part of the State of Illinois, the several formations are well marked lithologically, as the structure is simple and the most of the beds lie flat. With very few exceptions it has been possible to identify the various formations in the wells here discussed. (See Plates I to IV.)

IDENTIFICATION BY FOSSILS.

INTRODUCTORY STATEMENT.

The principal horizons containing a sufficient number of fossils for the purpose of identification are the Upper Devonian black shale (Sweetland Creek shale), Chester limestone, and the limestone overlying coal No. 6.

DEVONIAN BLACK SHALE.

General description.—In 1898 the writer had occasion to examine and describe a deposit of shale which lies below the Pennsylvanian, in Muscatine County, Iowa. It overlies unconformably the Cedar Valley limestone in this locality and its entire thickness is only about 40 feet. This shale is quite different from any shale in the "Coal Measures," in that it is more evenly developed and single layers of it only a few inches thick may be traced for several miles.

The upper part of the shale has a greyish-green color. Its lower part is dark, and this succeeded by some strata of dolomitic limestones at the base. These basal layers contain teeth of *Ptyctodus calceolus,* locally in abundance. The lower half of the formation contains also other fossils, such as:

Lingula, sp. undet.
L. cf. *melie* Hall.
Lingula, cf. *nuda* Hall.
Lingula subspatulata M. and W. (?)

Spathiocaris emersoni Clarke.
Solenocaris strigata Meek.
Ptyctodus calceolus M. and W.
Rhynchodus, cf. *excavatus* Newb.
Synthetodus.
Gasteropods.

There is also present in considerable abundance the fossil known as *Sporangites huronense*. This fossil is supposed to be a spore of some paleozoic plant, and consists of brown circular discs almost too small to be seen by the unaided eye. In some layers it is present in such abundance as to give the shale a brownish color. The spores consist of a bituminous substance, and when submitted to a distilling heat the shale gives out a considerable amount of oil and gas. The best exposures are in the banks of Sweetland Creek.

Under the Kinderhook limestone at Burlington, Iowa, there are some 300 feet of shale overlying the Devonian limestone. This shale has usually been referred to the Kinderhook group. Whether it is different from the Sweetland Creek shale, one overlying the other unconformably, or whether the two belong to the same formation is at present an undetermined question. The lower part of the shale at Muscatine was referred to the Chemung by Prof. Hall long ago, and its fish and crustacean fauna support this view.

During the progress of this study, the writer has found in several wells a shale resembling the Sweetland Creek shale. Its identification with the Sweetland Creek shale is believed to be sufficiently certain. It is based upon the similarity in texture and general appearance of both shales, on the presence in both of *Sporangites huronense,* on the presence in both of certain fossil fragments resembling denticles of annelids, and on the presence in some well samples of a *Lingula*. The formation varies in thickness from less than 100 to 300 feet, owing, no doubt, to the presence of an unconformity. (See Plates I and II.) The observations made on this shale in the several wells are as follows:

Galesburg City Well No. 3.—In the Galesburg city well No. 3, drilled in 1906, a light gray shale underlay the "Coal Measures" at a depth of 245 feet below the surface. With this shale were some pieces of white chert evidently from a remnant of the Burlington limestone above. More shale was taken from 330 feet below the surface. This was labeled "brown shale." It contained well-preserved *Sporangites* in abundance. When crushed by the drill these no doubt gave a brown color to the shale, that otherwise was gray. The next sample below this was from 380 feet below the surface and consisted of a soft, shaly limestone, probably Devonian. The shale at this place may be 100 feet thick.

The Old Monmouth City Well.—In the well drilled in 1887 at 410 North Sixth Street, in the city of Monmouth, a greenish-gray shale, no

doubt equivalent to the Kinderhook shale at Burlington, Iowa, extends from 168 to 299 feet below the surface. Under this there is a dark gray shale extending down to 427 feet below the surface. From this bed nineteen samples were taken about five feet apart, and in more than half *Sporangites huronense* is present. Some annelid denticles were also observed in one sample taken, 313 feet below the surface. The total thickness of the two shales is 261 feet.

Henry City Well.—From the old city well at Henry, Marshall County, drilled in 1886, one sample of drilling was taken representing the strata from 325 to 402 feet below the surface. A part of this sample consists of shale belonging to the "Coal Measures" which in this well extends from 130 to 325 feet below the surface. This is mostly white, finely granular limestone, probably Devonian.

Schuyler Oil and Gas Company's Well.—This well was made in 1909 on a farm belonging to Mr. W. B. Manlove in Birmingham Township, Schuyler County, about four miles southeast of Plymouth. The Mississippian limestones in this boring continue down to 240 feet below the surface and are underlain by 450 feet of shale. The descriptions of the samples from 246 to 683 feet below the surface are as follows:

Partial record of Schuyler Oil and Gas Co.'s well, near Plymouth, Illinois.

Description of rocks penetrated.	Depth in feet.
Light shale, with fragments of limestone	246
Light blue shale, with much pyrite in small crystals. Fragments of calcareous limestone frequent	280
Light blue shale, with pyrite and calcareous fragments	292
Light, greenish blue shale, with pyrite	295
Light, greenish blue shale, with only infrequent crystals of pyrite	302
Light, greenish blue shale. No pyrite noted	302
Light, greenish blue shale	310
Light, greenish blue shale	320
Greenish gray shale, with poorly preserved specimens of *Sporangites* occurring sparsely	330
Greenish gray shale, with *Sporangites*	340
Greenish gray shale, with poorly preserved specimens of *Sporangites*	345
Gray shale, faintly micaceous, with *Sporangites*	355
Gray shale, with abundant *Sporangites* and occasional crystals of pyrite	365
Gray shale, with *Sporangites* poorly preserved	400
Light gray shale, micaceous with comparatively thick specimens of *Sporangites*, and shapeless fragments of resinous material which appear to be shreds of *Sporangites*	415
Shale, almost black, showing reflections of minute scales of mica. A highly bituminous rock which burns for a few minutes after it has been thoroughly ignited. On the split surfaces of some large fragments several small specimens of *Lingula* were noted, about one millimeter in diameter. The distance from the umbo to the ventral margin of the valves was slightly greater than the transverse distance. Faint lines radiated from the umbo and distinct concentric lines of growth were seen. Irregular minute tubercles appear on the outer part of the valves. This black shale appears as a yellow translucent mass in transmitted light under the lens	511
A highly bituminous limestone, most of which effervesces brickly with acid. Some efferesces hardly at all. Some of the sample is crystalline calcite. Some bituminous fragments burn, when ignited, for a few seconds. The label on the sample was blurred, 5?1, but its highly bituminous character makes it probable that it is from about the same depth as the previous sample. Near (?)	511
Green clay shale, not effervescing in acid	600
Greenish-gray shale of very fine plastic texture, effervescing slightly with acid, containing a valve of an *Estheria?* Label indistinct; 680 or 683	683

Under this lay 270 feet of limestone, probably partly of Devonian and partly of Trenton age.

The Peoria Glen Oak Park Well.—This well record shows 150 feet of drift, 250 feet of "Coal-Measure," 125 feet of Mississippian limestone, and under this 195 feet of shale, of which at least the lower 70 feet are to be correlated with the Sweetland Creek shale. This rests on calcareous limestone believed to be of Devonian age. The samples examined were as below:

Partial record of Glen Oak Park well, Peoria, Ill.

	Depth below surface in feet.	
	From.	To.
Greenish gray shale with fragments of sponge spicules. Some fragment of a bluish translucent rock show a network of embedded spicules (Kinderhook)	525	590
Gray, slightly micaceous shale with crystals of pyrite and indistinct specimens of *Sporangites huronense*	590	650
Like the preceding, with frequent specimens of *Sporangites huronense*	650	720

The K. and E. Young well No. 29, Clark County.—From the depth of 1205 feet to 1210 feet in this well a black bituminous shale was noted, which the writer believes to be the equivalent of the Sweetland Creek shale. It was represented by a single fragment in a sample which otherwise consisted of limestone, and had without doubt come from a stratum some distance higher up in the well.

Lulu Shover well No. 1, Clark County.—The sample representing the part of this well from 1600 to 1690 feet consists of a highly bituminous shale of the characteristic appearance of the Sweetland Creek shale, and it contains readily recognizable spores identified as *Sporangites huronense.*

CHESTER FORMATION.

In some of the Chester formation *Pentremites* exists in such numbers that recognizable fragments of this fossil may come up with the drillings. Such was the case in the Illinois Coal and Coke Company's well at St. Johns in Perry County, where this fossil was found at 1100 and again at 1300 feet below the surface in association with fragments of *Archimedes.*

LIMESTONE ABOVE COAL NO. 6.

The limestone above coal No. 6 is a remarkably persistent feature in the "Coal Measures" throughout the State. This limestone measures from less than 100 to 600 feet in thickness. It varies in composition from a black, marly shale to a hard, white limestone. In the wells which penetrate this limestone in the southern part of the State, it was possible to identify the rock in one-half of the number by the presence of fragments of *Fusulina cylindrica.* In its outcrops in the northern and western part of the State this limestone invariably contains the fossil in such abundance that it usually can be found in every cubic inch of

the rock. It is believed that this fossil has a vertical distribution of less than 20 feet in the entire section of the "Coal Measures" in Illinois. In no well has the fossil been observed at more than one horizon. It can usually be found most readily in those sizes of drillings which measure from one-fourth of a millimeter to two millimeters in diameter. The fragments have almost invariably a dull, brownish-yellow colour on clean fractures, and they are readily identified by the internal structure peculiar to the fossil. Associated with this *Fusilina* are almost always to be found fragments of *Rhombopora lepidodendroides,* some peculiarly tuberculated pinnules of a crinoid, and sometimes entire shells of *Endothyra.* Most of the crinoid pinnules are less than a millimeter in length and have the general shape of a phalangeal bone of the human hand, possessing a longitudinal groove on one side, the opposite side being ornamented with exceedingly minute tubercles arranged according to a characteristic pattern. *Fusilina* seems to be particularly abundant in this limestone in the well in Marion County. In the oil fields of Crawford and Lawrence counties it is less common and does not always appear in drillings taken at intervals of five feet.

OTHER FOSSIL-BEARING FORMATIONS.

Besides these horizons which are characterized by the persistent recurrence of identifiable fossils, two other horizons may be mentioned in which characteristic fossils are more or less fortuitous. One of these is the St. Louis limestone, in which in a few wells very minute spines of echinoids occasionally may be found. These spines are usually so small that they can hardly be seen with a hand lens. Several specimens showing the sockets and lower ends of the spines have been noted. No doubt such spines may be found in other formations, but in the well samples of this State, none have thus far been noted except in the St. Louis formation.

In the upper "Coal Measures," that is, in that part lying above coal No. 6 some of the dark and grey shales contain shells of an *Ammodiscus* in sufficient numbers to be observed. This shell is also found in similar shales above coal No. 5, but it appears to be more abundant and larger in the upper part of the "Coal Measures." It may be added that joints of crinoid stems are profuse in much of the limestone of the Mississippian series and quite abundant in the limestones of the "Coal Measures." They are also frequently found in some samples from the earlier Paleozoic, as far down as the base of the Trenton. Bryozoa are abundant in the Warsaw of the Mississippian. They are noted in places in the Devonian and seldom absent from calcareous horizons in the Cincinnatian.

IDENTIFICATION BY PHYSICAL CHARACTERS.

ENUMERATION OF PHYSICAL CHARACTERS.

The physical characters which may serve to identify the various formations and horizons in the wells of this State are color, texture, and composition.

CHARACTERISTIC COLORS.

Some colors are characteristic of certain formations. Beginning with the lowest part of the geological column for this State, we find that the Potsdam sandstone with its associated shales is composed largely of red sandstone and some red shale. The red Potsdam sandstone is in some places a pinkish-red. The color seems to be inherent in the quartz itself to some extent. In part it is due to a coating of ocher on the surface of the grains. Above and below the St. Peter sandstone a few feet of shale are commonly present. This may be red, white, blue, or grey. The limestone of the Kinderhook is characterized, at least in the western part of the State, by a pinkish-red tint.

In the Chester formation blue shales alternate with red shales throughout the entire formation. Many of the red shales have a purple tint shading into green or blue. The sandy fire clay, which is nearly always present near the base of the Pennsylvanian in the western part of the State, is red in spots or streaks. Another horizon characterized by red shale lies between coal No. 6 and coal No. 7. This red shale is evidently not very thick and is locally absent. In the southwestern part of the State it is characterized in some places by hard shaly fragments which possess very thin and trenchantly marked laminations of red, dark grey, and light materials. At a level of some 300 or 400 feet above this coal red shale has in many places been found.

Dark, almost black, colors are to be noted in most shales that overlie coals or occupy coal horizons, but in the Pennsylvanian series of strata the variations from shale to fine silt and fine sandstone are so common that no level can be distinguished as being especially characterized by the presence of dark shales. A part of the Chester shales are dark, and the shales of the Upper Devonian, as observed in the central and northern part of the State, are almost black shales. A dark grey, dirty, or even black color also characterizes the lower part of the Cincinnatian shale where it is more or less bituminous.

Limestones are mostly white or grey. The Trenton is usually grey or light grey. The Galena formation is generally a faint straw-color, or light grey with a tint of yellow. The Niagara is mostly dull grey in its lower part, but in its upper 200 feet it may be yellow or pure white. Most of the Mississippian limestones are white or grey, in a few places yellow. In the St. Louis limestones have been found a few fragments

which have a peculiar and characteristic salmon-red color. This color is so different from any shade of red in the other limestones of this State, that it alone would almost be sufficient to identify these formations. Few fragments of this color are found in well samples, because they occur only in nests in the otherwise grey limestones.

The pink color of the Kinderhook limestone has already been noted. The limestones of the Pennsylvanian are quite variable in their shades, but they vary mostly between white and black. Black and color in these rocks is due mostly to the presence of bituminous matter, locally to the presence of pyrite. In the Mississippian limestones, as well as those of Pennsylvanian age, fragments of an intensely green mineral are seen in places. Such grains have not been observed in the Silurian and Ordovician limestones. The Lower Ordovician limestone especially the limestone lying a few hundred feet below the St. Peter sandstone, is commonly greenish from the presence of grains of glauconite.

CHARACTERISTIC TEXTURES.

Texture in sandstones.—In Illinois the texture of the Potsdam sandstone as shown from well samples, is quite variable, but coarse texture is less common in this group than is fine texture. In comparison with the St. Peter sandstone the grains of the Potsdam are more angular. Large portions of the Potsdam sandstone approach the limit of demarcation between sandstone and silty shales. This cannot be said of the St. Peter sandstone, nor of the upper sandstones lying in the Lower Magnesian formation.

The Lower Magnesian limestone consists in many places of sand grains in a calcareous matrix. The sand grains are well rounded and of about the same coarseness as those in the St. Peter sandstone. The proportions of sand grains and matrix vary so greatly that drillers frequently report sandstone beds in the limestone.

The St. Peter sandstone is coarse grained, the grains ranging from one to one-eighth millimeter in diameter. An invariable characteristic of the sandstone, so far as it has been observed in the well samples, is that its constituent grains are greatly worn, rounded, and polished. This feature also characterizes the sandstones in the upper part of the Lower Magnesian limestones. Another characteristic of the St. Peter sandstone is its freedom from foreign material. It will be recalled that this feature renders it suitable for the manufacture of glass.

The sandstones of the Mississippian series are, as a rule, of slightly finer texture than the Ordovician sandstones. Some of the Mississippian sandstones are also quite pure. In this series are also many limestones that contain embedded grains of quartz sand.

The Pennsylvanian sandstones in this State can usually be recognized by the angularity of their sand grains. The finer sandstones may frequently be recognized by the presence of a small ingredient of mica scales. Examined under a microscope the Pennsylvanian sandstones are seen to contain a few reddish and greenish grains and some grains of a dull-white color.

Some sandstones contain grains that have been enlarged by the crystallization of silica on their original surfaces.

In the terranes here explored enlarged sand grains are common in the lower part of the St. Peter sandstone and in the basal sandstones of the Pennsylvanian. Judging from a great number of observations on well samples it appears to the writer that such secondary growth is characteristic of basal sands overlying an unconformity. It is frequently to be noted in the basal sands of the Cretaceous of the West, as well as in the basal sands of the Pennsylvanian.

Texture in shales.—In texture, the shales and clays can hardly be said to present any characteristics peculiar to different formations. The Potsdam shales vary from the finest material to fine sand, and may or may not be micaceous. The shales lying above and below the St. Peter sandstone are also, so far as observed, of exceedingly fine texture, being plastic clays, rather than shales. The shales of the upper Devonian may be characterized as having an exceptionally uniform, fine texture, and as containing but little micaceous material. The same may be said of the shales of the Mississippian series. In the Pennsylvanian series the argillites vary between all extremes. The fire clays may be composed of the finest material or may be almost sand. The black shales overlying the coals do not show much mica. The sandy shales of the series are almost invariably micaceous and much of the material is so near the limit between fine sand and shale that it is sometimes reported as sand and sometimes as shale by the drillers.

Texture in limestones.—The most common distinction noted in the limestones in the northern half of Illinois is that between calcareous and dolomitic. A fairly constant stratigraphic level separates the dolomitic from the calcareous formations in the upper Mississippi valley. This level is the top of the Niagaran. With the exception of the Trenton, all the Silurian, Ordovician, and Cambrian limestones are magnesian, whereas the Devonian, Mississippian, and Pennsylvanian are in most places calcareous. Some strata in the Mississippian are dolomitic, and very rarely a few feet of dolomitic limestone are present in the Pennsylvanian series.

In the southern part of the State the process of dolomitization of the pre-Carboniferous limestones probably has not been the same as that farther north.

When sections are examined under the microscope all dolomites show a granular structure as they consist of minute crystals of dolomite. The size of these crystals is quite variable, ranging in the rocks here studied from nearly one-half millimeter in diameter to near the limit of visibility by a one-fourth inch objective. In the pre-Devonian rocks of Illinois there are two formations in which coarse dolomitic limestones are quite common: the Niagaran, especially its upper half, and the Galena. Usually fine-grained strata alternate with coarser strata, the changes being from ten to fifty feet apart. The dolomitic limestones in the Mississippian and in the Devonian series are, so far as observed, of fine texture.

Limestones which have not been changed to dolomites present a great variety of textures. They range between two extremes: those composed of impalpable calcareous material too fine to show any texture, and those composed almost wholly of calcareous particles, either of organic or of mechanical origin. Most calcareous limestones are mixtures of the coarse and fine ingredients. By far the larger part of all calcareous limestones in the formations here explored consist of organic material. Such is the Trenton limestone, the lower part of which is composed almost entirely of fragments of shells, poorly cemented in the southern part of the State. In the northern part of the State the Trenton contains finer calcareous material and is decidedly laminated, so that under the impact of the drill it generally breaks into thin, and more or less flat, pieces. The Burlington limestone is characterized by a profusion of crinoidal fragments, mostly joints of stems, that are composed of calcite which appears in the drillings largely as cleavage fragments.

Calcareous limestone of the finest, most compact texture, and containing scarcely any noticeable larger fragments is common in the St. Louis and in some parts of the Devonian. Rock of this kind is also occasionally to be noted in the Pennsylvanian and in the Chester.

Oolitic limestone characterizes the upper and lower parts of the St. Louis limestone, is rarely absent from the Kinderhook, and is also present in the Chester. The dolomitic, and sometimes chert-bearing, limestone in the Lower Magnesian also contains oolitic strata in some places and this structure appears in some of the cherts. The Chester oolites differ from most others in containing worn organic fragments, mingled in all gradations with oolitic spherules. The latter may have perfect shape or may be rounded, elongated, and flattened oolitic bodies containing central organic fragments. Many of the organic fragments

are well rounded and are covered with a calcareous coating which, no doubt, is of the same origin as the incrusting concentric layers of the oolitic spherules.

CHARACTERISTIC COMPONENTS.

Chert and flint.—Chert and flint are recognized by the smooth conchoidal fracture of their fragments and by their sharp and smooth edges as well as by the usually greater translucency of flint when compared with limestone. Pure flint is not affected by acid, but chert commonly contains calcareous material and must then be identified by its hardness. Occasionally samples from a formation will consist mainly of chert, but this happens only when samples are taken while the drill is working on some thin chert layer. Usually the chert and flint are present only in small quantity in limestone cuttings.

In the terranes of the northern part of the State flint and chert characterizes two horizons. They are almost invariably present in the drillings from the Burlington limestone, where they are so abundant in some places as to make up the larger part of the drillings. In the Niagara also some chert is nearly always found. Along the Mississippi it is evidently most abundant in the lower part of the formation. In some other limestones chert occurs with less regularity. It has been noted in the limestones of the Lower Magnesian, Galena, Devonian, St. Louis, and the Chester. Concretionary quartz is found at places in the Devonian limestone. In the northern part of the State this material is quite unlike flint in texture. It is exceptionally tough and is more translucent than flint, somewhat resembling agate or chalcedony in general appearance. In the southern part of the State the Devonian contains much chert. The Pennsylvanian limestones have not been found to contain chert or flint in any samples examined.

Glauconite.—Glauconite, consisting of dark green grains which are softer than limestone, is characteristic of the lower part of the Lower Magnesian limestones. In the upper 200 or 300 feet glauconite has not been observed in any of the samples examined.

Pyrite.—Pyrite, which is present in small quantities in all formations, is abundant at the contact of the Mississippian and the "Coal Measures" in some places, and also near the base of the Upper Devonian black shale.

IDENTIFICATION BY GROSS STRATIGRAPHIC FEATURES.

(SEE PLATES I TO IV.)

The Lower Cambrian system, so far as examined in this State, consists of sandstones and shales, some portions being red. Most of the red

sands are fine textured. The thickness of the shale beds is usually less than 50 feet, and contain in their upper portion some beds of sand or sandy limestone.

The St. Peter is a sandstone from 100 to 200 feet thick locally including some soft shale above or below or at both horizons.

The Trenton in the northern two-thirds of the State is a thin-bedded, usually calcareous, limestone about 100 feet thick. In well drillings it is usually not to be sharply differentiated from the overlying Galena limestone.

The Galena limestone is dolomitic, but otherwise like the Trenton, with which it makes a single limestone terrane some 400 feet thick. It is usually water bearing.

The Cincinnatian is a shale commonly containing considerable calcareous material and some limestone. It ranges in thickness from less than 100 feet to more than 200 feet.

The Niagara (Silurian) is a limestone which may be entirely absent or have a thickness of 400 or 500 feet. It is separated from the overlying Devonian by an unconformity.

The Devonian consists of two main divisions: (1) At the bottom limestones, which may be absent or attain a thickness of 150 feet in the northern part of the State, but have a possible thickness of 1,500 feet or more in the southern part; (2) shale locally absent or varying from 200 to 300 feet. It is not yet known whether this shale is separated from the overlying Kinderhook shale by an unconformity. The two appear in some well records as one continuous shale formation more than 400 feet thick.

The lower portion of the Kinderhook consists of the shale just mentioned. Its upper part consists of limestone and some shale or shaly limestone. The thickness of the formation cannot be definitely determined from deep borings. It is probably less than 50 feet thick in many places and never much more than 100 feet thick.

The Burlington limestone possesses a fairly uniform texture. It is probably everywhere less than 100 feet thick.

The St. Louis (including the Keokuk, Warsaw, Salem, St. Louis proper, and Ste. Genevieve) is a variable succession of limestones and shales about 600 feet thick. Its upper part usually contains a continuous bed of limestone 250 feet thick.

The Chester is a variable succession of sandstone, limestone, and grey, green, and red shales, comprising a total thickness of about 600 feet.

The Pottsville consists of less than 100 to 300 or 400 feet of sandstones and shales. The shales are characterized more or less by thin,

grey, and almost black, laminations many of which are less than one-fiftieth of an inch thick. Some thin coal seams exist in the formation.

The Pennsylvanian may be absent or may include sandstone, shale, limestone, marl, fire clay, and coal which merge into one another at short distances. The thickest sandstones lie in its lower 200 feet, and most of the limestone is above these sandstones. The general character of the Pennsylvanian sediments in the oil fields in southeastern Illinois has been determined by a study of samples from the following nine wells:

Crawford County—
O. F. Edwards, No. 15.
J. M. Drake, No. 23.
J. C. Wilson, No. 21.
M. Shiltz, No. 7.
C. F. Curtis, No. 8.
C. T. Cochran, No. 9.
C. E. Siler, No. 4.
L. R. Newlin, No. 22.
Lawrence County—
W. B. Gray, No. 2.

Note was taken of the thickness of each separate bed penetrated in these wells, as near as it could be determined from the drillings examined. The sediments were classified as sandstone, shale, limestone, coal, fire clay, and "clod." By the latter term were designated such calcareous layers or clayey limestones as lie immediately above some coal beds. The number of beds falling between certain indicated limits of thickness was ascertained separately for that part of the Pennsylvanian (McLeansboro) which lies above coal No. 6, and for the part lying below this coal (Carbondale and Pottsville). It will be seen that most of the distinguishable beds penetrated are less than 10 feet thick in both parts of the section. No beds of coal, fire clay, or "clod" measured more than five feet. Most of the beds measuring 50 feet and more are shale, only six sandstones having this thickness. Limestones are decidedly fewer and thinner in the lower part of the section than in its upper portion.

The number and thickness of Pennsylvanian strata above coal No. 6.

Kind of rock.	Limits of thickness in feet.													
	0–5.	6–10.	11–15.	16–20.	21–25.	26–30.	31–35.	36–40.	41–45.	46–50.	51–55.	56–65.	66–75.	75–130.
Sandstone	16	21	15	10	9	10	4	....	5	2	....	....	1	3
Shale	25	16	19	9	4	7	5	3	2	3	1	2	2	5
Limestone	29	13	8	4	2	....	....	....	....	....	....	....	....	....
Coal	37	....	....	....	....	....	....	....	....	....	....	....	....	....
Fire clay	13	....	....	....	....	....	....	....	....	....	....	....	....	....
"Clod"	5	....	....	....	....	....	....	....	....	....	....	....	....	....
Total	125	50	42	23	15	17	9	3	7	5	1	2	3	8

The number and thickness of Pennsylvanian strata below coal No. 6.

Kind of rock.	Limits of thickness in feet.													
	0–5.	6–10.	11–15.	16–20.	21–25.	26–30.	31–35.	36–40.	41–45.	46–50.	51–55.	56–65.	66–75.	75–130.
Sandstone	32	18	12	11	7	1	....	1	1	....	....	....	....	....
Shale	24	34	15	12	7	9	5	3	2	5	3	2	2	4
Limestone	11	1	1	....	1	....	....	....	....	....	....	....	....	....
Coal	56	....	....	....	....	....	....	....	....	....	....	....	....	....
Fire clay	6	....	....	....	....	....	....	....	....	....	....	....	....	....
"Clod"	8	....	....	....	....	....	....	....	....	....	....	....	....	....
Total	137	63	28	23	15	10	5	4	3	5	3	2	2	4

Taking the same measurements and averaging them for the different rocks in the two divisions we find the average thickness of the different kinds of sediments to be as indicated below. The measurements of the coals are, of course only estimates.

Table showing the average thickness, in feet, of the Pennsylvanian strata above and below coal No. 6.

Kind of rock.	Above coal No. 6.	Below Coal No. 6.
Shale	22.5	24.6
Sandstone	21.1	16.7
Limestone	7.5	4.3
Fire clay	4.6	5.6
"Clod"	4.7	5.2
Coal	1.5	1.2

It will be seen that the limestones and shales are slightly thicker in the upper division, and the sandstones in the lower division. The relative importance of the different rocks in each of the two divisions of the Pennsylvanian may also be determined from the same measurements with a fair accuracy by simply recording in percentages the number of feet of each kind of rock penetrated by the drill. These percentages are as follows:

The percentages of various Pennsylvanian strata above and below coal No. 6.

Kind of rock.	Above coal No. 6.	Below coal No. 6.	In both divisions.
Shale	54.7	71.0	61.8
Sandstone	33.2	21.9	28.5
Limestone	8.5	1.8	5.7
Coal	1.4	2.1	1.7
Fire clay	1.4	1.6	1.4
"Clod"	.6	.9	.7

This table shows that sandstone and limestone are relatively more important in the upper division and shale in the lower division.

PART II.—WELL RECORDS.

INTRODUCTION.

On the following pages are recorded observations made on samples of drillings from 43 wells in different parts of the State (Plate I). They have been prepared for the use of professional workers in stratigraphic problems, and for reference use by parties interested in data near the localities represented. It is hoped that these descriptions will furnish a fullness of stratigraphic detail that may prove of permanent value to future workers in the State. They represent a part of the stratigraphic data that have been preserved during the extensive exploration of the oil-bearing horizons in the south part of the State in the last decade. They can therefore never be duplicated. However, many similar observations may be added by future workers. They are presented for preservation by publication with about the same object as detailed observations are made, tabulated, recorded, and published, by workers in other sciences, as paleontology and astronomy. Also the publication of descriptive accounts of underground stratigraphic observations is desirable because it is often of economic importance to local business enterprises. To the general student of geological literature these pages are of course of little interest, unless it be in giving brief notes expressing the observer's judgments and conclusions on the stratigraphy of the localities represented. Reference should be made to Plates I to IV.

1. WELL OF ELGIN WATERWORKS, ELGIN, KANE COUNTY.

In 1901 and 1903 the City of Elgin made four deep wells to furnish the main public water supply. These wells are within 600 feet of each other. They are located at the waterworks near the intersection of Spring and Water streets, about one and one-fourth mile north of the Elgin Post Office. Three of the wells are about 1,350 feet deep, and the fourth about 2,000 feet deep. The principal water beds are at depths ranging from 560 to 702 feet and from 1,050 to 1,300 feet. One well has a diameter of twelve inches for a depth of 702 feet and another has the same diameter down to 1,200 feet. Below this the diameters are eight inches. The elevation of the curbs above sea level is 742 feet, and

none of the wells flow, but the original level to which the water rose was not far from the surface. The maximum yield of each well by pumping is 500,000 gallons in twenty-four hours.

Mr. R. R. Parkin, superintendent of the waterworks, who furnished the above data, also records that the strata penetrated in the four wells were identical, and describes them for two of the wells, as below. He has also kindly furnished the writer with a set of samples of the drillings from one of the wells, with labels indicating the part of the section from which each sample was taken. The samples were submitted in 1909. The other data were furnished in July, 1906.

Parkin's record of well 1,300 feet deep.

	Depth in feet.
Drift	39
Limestone	65
Shale	115
Niagara limestone, dark	185
Niagara limestone, light	325
Niagara limestone, brown	400
Mixed shale	485
Trenton limestone	560
Saint Peter sandstone	640
Saint Peter sandstone white	702
Lime, Lower Magnesian	750
Lime, Lower Magnesian, hard	850
Lime and shale, hard	880
Sand, pink	950
Pink limestone	1,050
Sandstone	1,300

Parkin's record of well 2,000 feet deep.

	Depth in feet.
Drift	38
Limestone	65
Shale	115
Niagara limestone, dark	185
Niagara limestone, light	325
Niagara limestone, brown	400
Mixed shale	485
Trenton limestone	560
Saint Peter, sand, dark	640
Saint Peter, sand, white	702
Lime, Lower Magnesian	750
Lime, Lower Magnesian, hard	850
Lime, hard, like shale	880
Sand, pink stained	950
Pink limestone	1,050
Sandstone, dark	1,350
Sandy limestone	1,580
Medina sandstone	1,625
Madison sandstone	1,645
Potsdam sandstone, dark	1,800
Potsdam, red sandstone	1,880
Mixed lime with sand	2,000

Description of the samples from the Elgin well.

(NOTE.—The writer's interpretations are indicated in italics.)

	Depth in feet. From.	To.
Silurian, Niagaran, 21 feet.		
Limestone, dolomitic, straw-color, crystalline and porous	39	60
Ordovician, Cincinnatian, 60 feet.		
Dolomitic shale, soft and bluish-gray	60	120
Ordovician, Galena-Trenton, 520 feet.		
Dolomitic limestone, coarse in texture, with some calcite, and pyrite, color dark, slightly bituminous	120	185
Limestone, white dolomitic, porous	185	482
Limestone, gray, dolomitic, with fairly coarse texture	482	500
Limestone, dolomitic, of fine texture, bluish gray	500	640

Locations of deep wells studied.

Description of the samples from the Elgin Well—Concluded.

	Depth in feet. From.	To.
Ordovician, St. Peter, 62 feet.		
Rounded quartz sand, white	640	702
Ordovician, Oneota, 313 feet.		
Dolomitic limestone, white with a few dark greenish specks. Some doubtful oolitic grains noted	702	750
White dolomitic limestone, with chert and occasional sand grains.	750	880
White dolomitic limestone, with some sand	880	950
Sandy marl, red, with some green grains	950	1,015
Cambrian, Potsdam, 990 feet.		
White sand, grains rounded and fairly coarse, with some chips of green shale and some bright green material in small fragments	1,015	1,300
Sandstone, fine grained, reddish gray, grains visible under a good hand lens	1,300	1,350
White quartz sand, with some rounded grains and some grains with facets due to secondary growth. Some grains were held in a dolomitic matrix, which was seen to contain green grains of glauconite	1,350	1,580
Gray shale, marly and sandy	1,580	1,635
Red sandstone	1,635	1,700
Coarse yellow sand	1,700	1,778
Yellowish sand, some grains of a pink color, many grains with crystal facets due to secondary growth	1,778	1,880
Coarse sandstone, with many grains of pink color, and many grains showing secondary growth. Some glauconite grains were noted in the cementing matrix, and there were small fragments of a fine, red sandstone	1,880	1,980
Brown, quite coarse, sand, with rare fragments of glauconite	1,980	2,005

2. WELL NO. 3, CITY WATERWORKS, BLUE ISLAND, COOK COUNTY.

The city of Blue Island drilled the third well for its waterworks near the northeast corner of its lot, the work beginning on June 1, 1909, and being finished on March 3, 1910. John W. Alvord and Charles H. Burdick, hydraulic engineers in Chicago, took samples from the drillings the entire depth of the well. The surface elevation of the well is 640.9 feet above mean sea level, and the static water level at the time the well was finished was 469 feet above sea level, or 172 feet below the surface. The size of the bore is as follows:

Depth in feet. From.	To.	Diameter in inches.
0-	69.4	20
69.4-	251.6	16
251.6-	506.1	10
506.8-	985.8	8
985.8-	1579.8	6

The engineers in charge examined the samples and have furnished the following descriptions and determinations of the formations which they represent. These, according to the judgment of the writer, are correct.

Record of well No. 3, Blue Island, Illinois.

	Thickness in feet.
Pleistocene, drift.	
Sand	59
Clay	3
Silurian, Niagaran.	
Limestone	408
Ordovician, Hudson River, Cincinnatian.	
Shale	105
Ordovician, Galena-Trenton.	
Limestone	334

Record of well No. 3, Blue Island, Illinois—Concluded.

	Thickness in feet.
Ordovician, St. Peter.	
Sandstone	145
Ordovician, Oneota.	
Limestone	275
Limestone, limestone and sandstone, sandstone and "pebbles" at (1440), and sandstone	136
Cambrian, Potsdam.	
Sandstone	185
	1,650

On March 9th a test of the yield of water was made by the engineers in charge, and it was found that when the well was pumped at the rate of 306 gallons per minute, and when well No. 1 was at the same time being pumped to supply the city, the level of the water in well No. 3 was lowered from 186 to 201 feet in four hours.

An analysis of the water from well No. 3 was made by the Dearborn Drug and Chemical Works in Chicago and is given as below:

Analysis of water from well No. 3, Blue Island, Illinois.

(In grains per U. S. gallon of 231 cubic inches.)

Silica (SiO_2)	.385
Oxides of iron and aluminum (Fe_2O_3, Al_2O_3)	.151
Carbonate of lime ($CaCO_3$)	6.416
Sulphate of lime ($CaSO_4$)	27.729
Carbonate of magnesium ($MgCO_3$)	7.335
Sodium and potassium sulphates (Na_2SO_4 and K_2SO_4)	16.101
Sodium and potassium chlorides (NaCl and KCl)	11.560
Loss, etc.	.169
Total solids	89.846
Total incrusting solids	42.016
Total non-incrusting solids	27.830

From a blue-print section of the well prepared by Alvord and Burdick it appears that their determinations of the geological formations were made from no less than 132 samples, taken usually at intervals five or ten feet. A set of fifty-seven of these samples was furnished the writer. Descriptions and determinations of these follow. It will be noted that there are some discrepancies between the depths at which some of these samples are reported to have come and those given in the section by Alvord and Burdick. This is due to the fact that a correction was applied by the engineers to the figures in the section, whereas the depths marked on the samples have been left as first recorded by the drillers.

Description of samples from well No. 3, Blue Island, Illinois.

	Depth in feet.
Pleistocene. Not represented in samples.	
Silurian, Niagaran.	
Dolomitic limestone, of fine-grained crystalline texture, a few fragments with a greenish tinge and some black specks that lack sharp outlines	75
Dolomitic limestone, like the preceding	150
Dolomitic limestone, white and grayish white, with rare fragments of white chert	175
Dolomitic limestone, almost white, with some fragments of a faint greenish color	200

Description of samples from well No. 3—Continued.

	Depth in feet.
Silurian, Niagaran—Concluded.	
Dolomitic limestone, moderately coarsely crystalline, quite porous; bulk grayish white, some fragments faint purplish, others faint greenish..	250
Dolomitic limestone, white and grayish white; some compact and some porous	350
Dolomitic limestone, grayish white, compact, with frequent fragments of white chert	375
Dolomitic limestone, gray, compact. The gray aspect is due to the presence of microscopic grains of pyrite	400
Dolomitic limestone, grayish white, fairly compact	425
Dolomitic limestone, gray, coarsely crystalline. Bright yellow pyrite noted	450
Ordovician, Cincinnatian.	
Shale, dark gray, darkening and emitting faint bituminous and then strong sulphrous odors on heating in open tube. It contains minute spherical grains of pyrite and black shreds of carbonaceous material. Effervesces with acid	465
Shale, darkish gray, calcareous, with fragments of dark dolomitic limestone that turns black when heated; with many crystals of selenite from 1 to 5 mm. in length, and much pyrite in minute crystals	475
Shale, dolomitic, darkish gray, with fragments of dark, dolomitic limestone turning black when heated, and with many grains of pyrite. The apical whorls of a small gasteropod were noted and also a circular flat disc .2 mm. in diameter	500
Shale, dark gray, dolomitic, laminated, with brown, stony material in thin laminae and considerable yellow pyrite	545
Shale, gray, showing minute black specks on cleavage surface; with some fragments of dark dolomitic limestone and some light yellow pyrite present	570
Ordovocian. Galena-Trenton.	
Dolomitic limestone, of light gray color	590
Dolomitic limestone, light gray	595
Like the preceding	630
Like the preceding, some fragments porous	700
Dolomitic limestone, light gray	750
Like the preceding	780
Like the preceding, with some dark thin fragments	800
Dolomitic limestone with some dark fragments	850
Like the preceding	880
Ordovician, St. Peter.	
Quartz sand, of fairly coarse, rounded grains. A considerable part of the sample consists of such sand firmly cemented by a compact matrix of marcasite. Some fragments are dolomitic limestone showing somewhat brisk effervescence with acid. Other fragments consist of rounded sand embedded in dolomitic limestone as matrix. Evidently all of these variations of rock are contact phenomena	900
Quartz sand, clear, rounded, average diameter of grains about .25 mm.	910
Like the preceding	970
Like the preceding	1,050
Quartz sand, clear and rounded grains, with some white chert and some clay which is calcareous	1,075
Ordovician, Oneota.	
Dolomitic limestone, compact, faintly straw-white and of characteristic luster; with some pinkish dolomite, and some olive-colored and shaly dolomitic limestone. There are also some large fragments of green shale, some rounded clear sand, and some fragments of calcareous limestone	1,085
Dolomitic limestone, white and grayish white, some fragments of dull olive color, and occasionally fragments of light green color	1,105
Dolomitic limestone, white; "mortar rock," consisting of fine sand embedded in a matrix of white dolomitic material; some white chert. Occasional grains of the embedded sand are green, and some pinkish red. Some dolomitic fragments are bright green	1,155
Dolomitic limestone, white, with frequent fragments of a light, bright green material which does not effervesce in acid. Some of this is stony and dolomitic, some as soft as talc. A few fragments of grayish white chert were noted	1,175
Dolomitic limestone of dull cream-color and coarse crystalline texture, crystals measuring one-eight mm. in diameter; occasional fragments of pink dolomite, and of green serpentine-like shale	1,220
Dolomitic cream-colored limestone, with a few fragments of calcite. Some fragments of small clear quartz crystals .5 mm. to 1 mm. in diameter, some green shale fragments, measuring about .125 mm. in diameter	1,300
Dolomitic, cream-colored limestone with much pyrite, mostly in cubic crystals .125 mm. in diameter, also occurring in small spherical clusters; and with crystals of quartz, terminating in pyramids at both ends, and measuring about one-third mm. in length	1,320

Description of samples from well No. 3—Concluded.

	Depth in feet.
Ordovician, Oneota—Concluded.	
Dolomitic limestone, cream-colored, constitutes about half the sample. The other half is fine quartz sand. Less pyrite than in previous sample, crystals cubic, octahedral, and dodecahedral. The dolomite shows minute black specks, also some similar specks of dark green color. Pyrite in process of formation from glauconite (?)	1,330
Dolomitic limestone, cream-colored, and containing embedded quartz sand, small crystals of pyrite, and minute grains of a dark green mineral, glauconite (?), measuring about .125 mm. in diameter	1,340
Like the preceding	1,350
Fine quartz sand and dolomitic limestone. The latter contains small pyrite crystals of various forms, and grains of glauconite of the same size. Both appear together in the same fragments	1,360
Sandstone, gray, grains averaging from .125 mm. to .25 mm. in diameter. These are embedded in a matrix of dolomitic material which also contains much glauconite and some pyrite in grains of equal sizes	1,400
Fine quartz sand in a matrix of dolomite. The two are of about equal quantities, some pyrite is in coarser crystals than in the preceding samples. The glauconite grains are larger, more abundant and darker than in the preceding sample	1,410
Like the preceding sample, but the glauconite is darker, and the pyrite is less in quantity	1,420
Most of the material like that in the preceding sample, but there are also fragments of a dark greenish gray dolomite, of a light colored dolomite, except for a few green specks, and some lumps of a dark gray fissile dolomitic shale	1,430
Dolomitic, dark gray limestone, with fine quartz sand, containing small grains of glauconite, and considerable pyrite in larger crystals than in the preceding sample. A part of the sample consists of a comparatively coarsely crystalline and porous dolomite, without glauconite, but with comparatively large crystals of pyrite. There were also sphalerite, calcite, chert, and quartz	1,440
Fine sandy and coarsely crystalline, porous dolomitic limestone, like the two types of rocks in the preceding sample. The porous dolomite is present in greatest quantity and occurs in large fragments with free crystalline surfaces. Evidently from cavernous places in the rock. In a single fragment of rock, midway between the two types in coarseness, two glauconite grains were noted. It may be inferred that the two types grade into one another. In some large lumps of the porous rock were noted a thin vein of dolomite, a change from medium to very coarse dolomitic crystals on a free surface, large crystals of pyrite, of sphalerite, calcite, quartz, and barite. There are also some lumps of cavern clay. The drill here evidently passed through a mineralized place in the formation	1,450
Cambrian, Potsdam.	
Rounded quartz sand with some grains, rusty on the surface. Size of grains from .25 mm. to .5 mm. in diameter	1,470
Rounded quartz sand, like the preceding, with a piece of gray shale probably from the cavernous place above	1,480
Rounded quartz sand, like the preceding, with two fragments of pyrites probably from 1,450 feet	1,490
Rounded quartz sand, as coarse as the preceding with most grains rusty on the surface and some coated black	1,530
Rounded quartz sand, like the preceding	1,550
Rounded quartz sand, slightly rusty on the surface of the grains	1,570
Like the preceding	1,590
Like the preceding, but slightly more rusty	1,620
Like the preceding	1,630
Mostly sand, like the preceding, but also some dolomitic limestone	1,640
Chiefly rounded rusty quartz sand, with some large and some small lumps of a fine-grained gray sandstone, and with a dolomitic matrix	1,650

3. CROWLEY AVENUE WELL, JOLIET, WILL COUNTY.

Near the crossing of Crowley Avenue and Ottawa Street the city of Joliet has sunk a well 1621 feet deep, from the drillings of which some sub-samples were obtained in 1909. The original samples were preserved in bottles kept in the office of the city engineer.

Description of samples from well at Joliet, Illinois.

	Depth in feet.
Gray fine-textured dolomitic limestone	50
Gray, faintly yellowish dolomitic limestone	375
Gray, dolomitic limestone	630

Description of samples from well at Joliet—Concluded.

	Depth in feet.
Gray, dolomitic limestone, crushed fine by the drill	710
White sand, consisting of rounded coarse grains	800
Like the preceding	850
Sand, dull pinkish in color, of somewhat fine grains	900
Like the preceding	950
Yellowish sand	1,000
Yellowish sand	1,050
Dull pinkish sand	1,100
Fine sand of vermilion color	1,135
Red clay with small embedded lumps of soft white material. Neither the red nor the white effervesces with acid	1,150
Clay, of vermilion color; contains lumps of more stony material; has brownish gray specks and streaks. The stony fragments exhibit irregular slickensided joints. No part of the sample effervesces with acid	1,197
Mostly stony shale of vermilion red, brown, or almost black color, with some white or dull greenish shale. The sample also contained some white chert and some coarse, rounded grains of sand	1,218
A stony mixture of fine red clay and sand, with greenish streaks. A large unbroken fragment, five inches long, showed slickensides. The sandy streaks are greenish gray in color	1,240
Clay and sand with a small mixture of dolomitic material. A part of the sample is rusty red and some is greenish gray	1,310
Sand, rusty-orange-colored, more angular than typical St. Peter sand	1,400
Dark gray dolomitic limestone, some white soft sandstone, and some fragments of green shale	1,562
Like the preceding. The label has the note: "Water stands 143 feet below the surface"	1,565
Gray sand of somewhat angular grains	1,567
Olive green, grayish, clay with rusty brownish streaks. Label has the note: "Bottom of the well"	1,621

4. WELL OF C. W. REED, IN SEC. 25, T. 14 N., R. 9 E., PUTNAM COUNTY.

A record of the strata penetrated in this well was furnished the writer in 1893. Two flows at low pressure were obtained, one at between 1500 and 1600 feet below the surface, and another at about 1900 feet. The upper water is soft and fresh, the lower water is hard and a little salty. The lower water had a head of 10 feet in 1903 and was lifted by a ram. Its head had lowered somewhat in three years. The well had been cased to a depth below the 1,100-foot shale. The elevation of the well curb, as determined by the aneroid, is 730 feet above sea level. The record of the strata penetrated was as below:

Record of well in Sec. 25, T. 14 N., R. 9 E., Putnam County, Illinois.

	Thickness in feet.
Clay	16
Sand and gravel	12
Blue and gray clay	85
Sand and gravel	118
"Soapstone"	8
Shale	20
"Slate"	22
Black "slate"	8
Shale	34
"Soapstone"	7
Shale	12
Coal	5
Fire clay	5
Shale	13
Sandy shale	18
Shale	24
Not reported	48
Shelly rock	48
White lime rock	502

Record of well in Sec. 25, T. 14 N., R. 9 E.—Concluded.

	Thickness in feet.
Blue shale	180
Gray lime rock	239
Gray lime rock	121
St. Peter sandstone	135
Blue shale	10
Sand rock	8
Shale	5
Rock and shale	32
Sand rock and shale	75
Lime rock	60
Sand rock	79
Sandstone	42

The writer's interpretation of the above record is as follows:

Interpretation of record of well in Putnam County, Illinois.

	Depth in feet. From.	To.
Drift	0	226
Pennsylvanian	226	375
Devonian	375	460
Undetermined	460	500
Niagaran	500	1,010
Cincinnatian	1,010	1,190
Galena-Trenton	1,190	1,550
St. Peters sandstone	1,550	1,685
Oneota	1,685	1,990

5. CITY WELL, CHATSWORTH, LIVINGSTON COUNTY.

In 1910 the writer received from Mr. G. W. McCabe of Chatsworth 41 samples of drillings taken at intervals of from 5 to 170 feet from a churn-drill boring made in that city in 1907. The well is located on the SE. ¼, sec. 3, T. 26 N., R. 8 E., 50 feet northwest of the post office in Chatsworth. The samples were carefully taken and distinctly labeled. The diameter of the well at the top is 14 inches and at the bottom 6 inches. When highest the water from the St. Peter sandstone stands 40 feet below the surface. At an earlier date a record of the strata penetrated in the well was obtained by the Illinois State Geological Survey. This record is as follows:

Record of city well at Chatsworth, Illinois.

	Thickness in feet.
Soil and clay	4
Yellow clay	4
Blue clay	44
Sand and gravel	8
Blue clay	10
Sand	5
Hardpan	53
Sand	7
Hardpan and clay	52
Soft clay and gravel	13
Soapstone	21
Limestone	348
Black slate	40
Gritstone	80
Limestone	135
Dark shale	36
Limestone	147
Flint	109

Description of samples from the city well at Chatsworth, Illinois.

	Depth in feet.
Dark gray shale with streaks of flint	84
Boulder clay (April 19, 1907)	80
Boulder clay, silt, sand and gravel (April 23, 1907)	118
Gravel and sand (April 26, 1907)	138
Boulder clay, (May 1, 1907)	150
Boulder clay, (May 2, 1907)	165
Boulder clay, (May 4, 1907)	180
Boulder clay, (May 7, 1907)	200
Boulder clay, (May 8, 1907)	220
Silt containing drift pebbles. This silt resembles the deposit known in the northern part of the State as the Silveria formation, a preglacial or a glacial silt, (May 9, 1907)	240
Chiefly boulder clay. Some sand and a coal-measure concretion also in the sample, (May 9, 1907)	260
White dolomitic limestone, with crystals less than .125 mm. in diameter, and of compact texture. The rock is speckled with rounder grains of a dark green mineral, from .125 mm. to .06 mm. in diameter. These grains lie promiscuously through the rock and close enough for about one hundred to appear on a ground surface of one square inch. Some fragments of a dark gray chert were noted, (May 14, 1907)	280
Dolomitic limestone, cream-white, with considerable white chert which shows traces of organic structure, (May 15, 1907)	287
Dolomitic limestone of cream-white color, some fragments porous. A part of this sample is a large lump of grayish white cavern clay (?) of the finest texture. This gives no response to acid; checks off into conchoidal fragments while producing a sizzling sound, when submerged in water, (May 16, 1907)	315
Dolomitic limestone of a cream-white color, with dark streak, and with occasional grains of a green mineral, some of which are a millimeter in diameter. One piece of a crinoid stem was noted and some sand, (May 17, 1907)	325
Dolomitic limestone, some yellowish gray, some dark gray, also some gray shale with grains of a green mineral disposed in layers, (May 21, 1907)	400
Gray dolomitic limestone, (May 22, 1907)	420
Like the preceding, May 22, 1907)	440
Gray dolomitic limestone, porous, (May 23, 1907)	460
Dolomitic limestone, nearly white, (May 24, 1907)	475
Dolomitic limestone, light gray, fine in texture, (May 24, 1907)	490
White dolomitic limestone, fine grained, (May 24, 1907)	505
Like the preceding, (May 25, 1907)	510
White dolomitic limestone, (May 28, 1908)	590
Bluish white compact dolomitic limestone, clearly crystalline under lens, largest crystals .25 mm. in diameter. More than half of the sample is pinkish yellow in color and fine in texture, (May 28, 1907)	615
Dark gray shale and green shale, (May 30, 1907)	638
Green clay shale, somewhat calcareous, (May 30, 1907)	645
Green clay shale, somewhat calcareous, (June 1, 1907)	665
Green clay shale, not calcareous, with marcasite in minute crystals, (June 3, 1907)	690
Green clay shale, not calcareous, (June 4, 1907)	710
Gray calcareous limestone, with some white dolomitic limestone, and some green shale. Much pyrite, ground to fragments, (June 5, 1907)	724
Dark greenish gray shale, calcareous, (June 7, 1907)	765
Gray calcareous limestone with microscopic dark specks, in places seen to be pyrite. This rock splits into very thin fragments, most of which show fragmental texture, and which is incipiently silicified. With this is some almost black shale, which breaks into long flat splinters and effervesces with acid, (June 10, 1907)	820
Gray calcareous limestone, fragmental, with embedded siliceous sand grains. Also considerable dolomitic limestone. Some fragments were examined under the microscope, were seen to have parallel filaments of a black mineral, (June 12, 1907)	840
Gray calcareous limestone, showing many fragments from .25 mm. to .50 mm. in diameter; containing a few rounded quartz grains, and showing microscopic black particles of pyrite, (June 14, 1907)	865
Gray calcareous limestone of fragmental structure, with only a few microscopic particles of pyrite, (June 27, 1907)	920
Gray calcareous limestone, fragmental, (June 2, 1907)	1,000
Calcareous limestone, moderately dark gray, fragmental in texture, splitting into very thin chips, and containing some pyrite. The sample contained some material like that of the following sample—a black shale, (July 10, 1907)	1,120
"Probably caved in from about 800 feet." Two large unbroken pieces, about a pound in weight, of an almost black stony shale, or shady dolomitic limestone. When crushed and examined under the microscope, rock is seen to consist of some fragmental and some amorphous material, with broken pieces of dolomite crystals. In the amorphous translucent fragments are many black particles less than .02 mm. in diameter, probably pyrite. There were also noted some thin brown crustlike fragments of	

Description of samples from the city well at Chatsworth—Concluded.

	Depth in feet.
probably bituminous material. The rock effervesces slowly with acid, and when heated in a closed tube it yields bituminous and then sulphurous fumes. After heating it contains a few magnetic grains	1,120
Some gray calcareous limestone and some dolomitic limestone of similar appearance. Both contain embedded rounded grains of quartz sand, from .50 mm. to .125 mm. in diameter. Some pyrite noted, (July 19, 1907)	1,210
Rounded quartz sand from .50 mm. to .125 mm. in diameter. Some grains are partly stained yellow, giving the sand a yellowish gray color, (July 19, 1907)	1,224
White quartz sand of about the same coarseness as the sand in the previous sample. Much of the sand has evidently been crushed by the drill as many of the grains are broken, (July 24, 1907)	1,285

It will be seen that there are several discrepancies between the record first quoted and a section based on these samples. According to the record the drift is only 200 feet thick, but according to the labeled samples it is at least 260 feet and may be as much as 280 feet in depth. The record mentions soapstones penetrated from 200 to 221 feet below the surface, whereas the sample from this depth is boulder clay, and the only sample containing anything that may belong to the "Coal Measures" is labeled 260 feet. Both the record and the samples show a limestone under the drift about 350 feet thick. This the writer believes is the Niagaran limestone.

Below this limestone the samples show a shale formation the thickness of which is at least 127 feet and may be 205 feet. In this shale ther is some limestone about half way down. This tallies with known changes in the Cincinnatian strata. In the written record the Niagaran is followed by 40 feet of black shale overlying 80 feet of "gritstone," a rather nondescript term.

Below the Cincinnatian the samples are limestone from 820 to 1210 feet below the surface with a hiatus of 55 feet above, giving room for 445 feet of limestone. At the depth of 1120 two samples were taken, one consisting of limestone resembling the nearest samples above and below, and another consisting of a black, stony shale. This sample consists of one large lump unbroken by the drill; and the collector makes the note: "Probably caved in from about 800 feet," i. e., from the lower, usually dark, horizon of the Cincinnatian.

In the written record the "gritstone" is underlain by two limestones, one 135 feet the other 147 feet thick. These are separated by 36 feet of dark shale, and are underlain by 109 feet of "flint" and 84 feet of "dark-gray shale with streaks of flint." The descriptive terms used suggest a lack of familiarity with the local rocks. It is believed that the lowest shale is limestone as shown by the sample, and that part of this limestone must have been cherty, though this is not shown in the samples. The 109 feet of flint is also thought to be cherty limestone. These 400 or 500 feet of limestone are believed to belong in the Galena-

Trenton formation. The greater part of the samples show a rock more clearly like the Richmond division than the Galena. The rock is organic fragmental and it is only incipiently dolomitized, and some is also apparently incipiently silicified. On etching a polished surface of the fragments with acid, dolomite crystals are seen to stand out in relief, the surface showing a reticulate texture. Siliceous grains, apparently an original ingredient in the rock, were present in the lowest sample.

The written record stops at 1200 feet, but three of the samples come from a greater depth, the two lowermost being sand believed to be of the St. Peter formation.

The following table represents the author's interpretation of all the data presented bearing on the formations penetrated in this well.

Interpretation of record of city well at Chatsworth, Illinois.

	Estimated thickness in feet. Minimum.	Maximum.
Drift, boulder, clay, etc	200	270
"Coal Measures," shale	0	21
Niagaran, limestone	348	378
Cincinnatian, shale and limestone	127	205
Galena-Trenton, limestone	390	500
St. Peter sandstone	61	?
Total depth of well		1,285

6. WELL NEAR PLANO, KENDALL COUNTY.

In March, 1909, Mr. C. A. Darnell of Plano submitted for examination some drillings taken from a well on the Fox River bottoms, two-and-one-half miles south and a little east of Plano. These samples were taken at depths mostly 15 feet apart, excepting for that part of the section extending from 385 to 590 feet below the surface, from which no samples were furnished. The labels gave the depth at which they were taken.

Description of samples from well near Plano, Illinois.

(NOTE.—The writer's interpretations are indicated in italics.)

	Depth in feet.
Ordovician, Galena-Trenton, 550 feet.	
Drift sand and some yellow dolomitic limestone	40
Like the preceding	55
Straw-colored dolomitic limestone	70
Straw-colored dolomitic limestone, with some chert	85
Dolomitic limestone, straw-colored	105
Dolomitic limestone, straw-colored, with some calcite	115
Like the preceding	130
Dolomitic limestone, straw-colored	145
Like the preceding	160
Dolomitic limestone, straw-colored, coarse in texture and with some chert	175
Dolomitic limestone, straw-colored, coarse texture	190
Dolomitic limestone, straw-colored	205
Like the preceding, with some calcite	220
Dolomitic limestone, mostly straw-colored, some white	235
Dolomitic limestone, straw-colored, with few fragments of white chert	250
Dolomitic limestone, straw-colored, with some white chert and some spar	265
Dolomitic limestone, relatively fine in texture, with some chert	280

Description of samples from well near Plano—Concluded.

	Depth in feet.
Ordovician, Galena-Trenton, 550 feet—Concluded.	
Gray dolomitic limestone, relatively fine in texture, with dark streaks and stains	295
Dolomitic limestone, straw-colored, fine grained, with occasional blotches	310
Dolomitic limestone, light gray, porous	325
Dolomitic limestone and rounded white quartz sand	385
Ordovician, St. Peter, 135+ feet.	
Quartz sand, somewhat fine grained, yellowish	590
Yellow quartz sand	605
White quartz sand	620
White quartz sand	635
Yellow quartz sand	650
White quartz sand	665
White quartz sand	680
Shale, dull purple, brown and greenish, with a fragment of oolitic chert and some sand	684
White quartz sand, with some pale green and soft grains	690
White quartz sand, with some pale green grains and some pink quartz grains	695
White quartz sand, with some green and some white grains and some limestone fragments	710
Ordovician, Oneota, 385 feet.	
Yellowish light gray dolomitic limestone, with some white chert, that occasionally shows green stained streaks, and with some fragments of the main rock, pale green	725
Quartz sand, with some yellow, some green, and some oolitic chert, and with some green, some dark, some brownish and some black shaly material	740
Gray dolomitic limestone with much oolitic chert and some other chert of chalcedonic luster, and with some green and soft material	758
Dolomitic limestone of yellowish gray tinge, with much chert and some pale green fragments	770
Quartz sand with some fragments of pale green material	785
White sand with some opaque white grains	800
Mostly white chert, some dolomitic limestone, and many pale green fragments	815
Dolomitic limestone with chert and sand	830
Dolomitic limestone, with chert and some sand, and with fragments of a green material like serpentine	845
White dolomitic limestone, with few fragments of serpentine-like material	860
Like the preceding	890
White dolomitic limestone	905
Like the preceding	920
Like the preceding	935
Like the preceding	965
Like the preceding	985
Like the preceding	990
Gray dolomitic limestone, with pyrite in small grains	1,005
Dark gray dolomitic limestone, containing grains of pyrite and a light green material	1,016
Fine quartz sand, with some dolomitic limestone	1,021
Dolomitic limestone, dark gray, with many minute dark green grains, probably glauconite, and some pyrite in small grains	1,030
Fine quartz sand and some dolomitic limestone with glauconite grains (?). Sample in water. (Supposed to be oily)	1,080
Dolomitic limestone, dark gray, fine-grained, with some pyrite. No green grains noted	1,095
Gray dolomitic limestone and sand	1,101
Gray dolomitic limestone with glauconite grains, and with pyrite grains. Some sand in the sample	1,103
Like the preceding	1,105
Dolomitic limestone and coarse quartz sand, with grains of glauconite and pyrite	1,110

7. WELL OF SAN BEDE COLLEGE, PERU, LASALLE COUNTY.

In 1892 the San Bede College at Peru had a well drilled to the depth of 2,300 feet, by J. P. Miller & Co. of Chicago. The well is located on the uplands west of Peru, near the buildings of the institution, and its curb has an elevation of about 609 feet above sea level, aneroid, checked to the Peru railroad station. When the well was nearly completed the writer obtained from the workmen a memory record of the strata penetrated. This record is given below.

Record of well at Peru, LaSalle County, Illinois.

	Thickness in feet. (Estimated)
Drift and "Coal-Measure" shales, sandstone, etc., with two seams of coal, one seams of coal, one at 450 and another at 500 feet below the surface	500
"Niagara" limestone	460
"Slate stone"	240
"Trenton" limestone	325
Sandstone (Saint Peter)	125
Some shale	3
Limestone	232
Sandstone	80
"Lime rock with quartz"	215
Sand rock	120

A few weeks later the writer called at the office of the drillers in Chicago and obtained the following additional notes, which were read by Mr. Miller from his note book.

Record of well at Peru, LaSalle County, Illinois.

	Depth in feet.
Drift	73
Shale, caving bad	190
Hard limestone	275
Shale, with streaks of lime	315
Fire clay	340
Sticky shale	355
Hard lime rock	838
Sticky shale	1,050
Hard lime, 990 to	1,150
Very hard rock	1,242
Hard lime	1,308
Hard white lime	1,343
Shale	1,650
Vary hard rock	1,750
Lime	2,000

The two records do not agree and two items in the notes obtained from Mr. Miller are contradictory. It is nevertheless evident that the strata penetrated in this well are about as indicated below.

Interpretation of record of well at Peru, Illinois.

	Thickness in feet.
Drift	73
Pennsylvanian	427
Devonian (?) and Niagaran limestone, with some shale above	460
Cincinnatian shale	240
Galena-Trenton limestone	325
Saint Peter sandstone	125
Lower Magnesian limestone and sandstone	650

No flowing water was obtained from this well.

8. WELL NO. 2, MINERAL POINT ZINC COMPANY, DEPUE, BUREAU COUNTY.

Drilling on this well was begun April 27, 1909, and completed to a measured depth of 1,278½ feet on August 14, in the same year. Samples were taken at depths from 5 to 55 feet apart and submitted to the writer for examination. A very full account of the progress of the work and a description of the strata penetrated were made by Mr. O. E. Ruhoff, under whose supervision the drilling was done. His record of the strata penetrated is as below.

Record of well No. 2, Mineral Point Zinc Company, DePue, Illinois.

	Depth in feet. From.	To.
Clay, yellow, soft	0	13
Gravel, coarse	13	35
Gravel, coarser	35	37
Fine gravel and sand	37	53
Clear sand	53	64
Gravel and sand	64	78
Shale, light, soft	78	90
Shale, dark, soft	90	100
Shale, light, medium hard	100	132
Shale, dark, medium hard	132	182
Coal, very lean	182	184½
Shale, dark, medium hard	184½	205
Shale, dark, harder	205	216
Shale, light, medium hard	216	227
Shale, dark, medium hard	227	272
Shale, dark, harder	272	275
Shale, light, medium hard	275	292
Shale, darker, medium hard	292	300
Shale, light, medium hard	300	345
Shale, dark, medium hard	345	352
Indications of coal	352	356
Cave-in, depth uncertain	356	360
Shale, light	360	371
Lime rock, white, soft	371	402
Lime rock, white, soft	402	498
Lime rock, white, soft	498	535
Lime rock, brown, medium hard	535	580
Lime rock, white, medium hard, hard at 605	580	632
Lime rock, darker and soft	632	703
Lime rock, white, medium hard, hard at 718, and from 738 to 850	703	850
Shale, light, hard	850	928
Shale and lime, light	928	950
Shale, light, hard	950	1,020
Lime rock, white, hard	1,020	1,065
Lime rock, white, medium hard	1,065	1,278

Mr. Ruhoff's notes on the water in the several strata are as follows:

Water from the depth of 395 feet rises to the surface part of the time.

Salt water from the depth of 580 feet flowed out at top of pipes at the rate of 5 gallons per minute.

Salt water from the depth of 680 feet flowed out at top of pipes at the rate of 20 to 25 gallons per minute.

Salt water from the depth of 788 feet flowed out at the top of the pipe at the rate of 20 to 25 gallons per minute.

Salt water flowed out at the top of the pipe at the rate of from 20 to 25 gallons per minute while drilling from 850 feet to 1,065 feet.

After casing down to 842 feet, fresh water was reached between 1,126 and 1,131 feet below the surface, and water flowed out at the rate of 45 to 50 gallons per minute.

Water from the depth of 1,175 feet flowed out at the top of the pipe at the rate of about 175 gallons per minute.

The flow from the depth of 1,205 feet was 250 gallons per minute.

The flow of water, by actual measurement, was 782 gallons per minute at the depth of 1,245 feet, and the current was strong enough to force lumps of lime rock to the surface.

A 15-inch casing was put down to the depth of 85 feet, a 10-inch casing to the depth of 392 feet, and an 8-inch casing to the depth of 842 feet.

Description of samples of drillings from well No. 2, Mineral Point Zinc Company, DePue, Illinois.

	Depth in feet.
Pleistocene, 73 feet.	
Sand and gravel	25
Sand and gravel, pebbles mostly of dolomitic limestone	32
Sand and gravel, gravel partly cemented, mostly dolomitic pebbles	39
Sand and gravel, clean	54
Clean sand	60

Description of samples of drillings from well No. 2—Continued.

	Depth in feet.
Pleistocene, 73 feet—Concluded.	
Yellow calcareous silt (glacial)	68
A pebble of decayed limestone, fossiliferous	69
Clean sand	75
Pennsylvanian, 298 feet.	
Gray shale, with some pebbles, from drift	132
Gray shale, with some pebbles, from drift	145
Shale, gray	172
Shale, gray	182
Black coaly shale	182
Shale, light gray, slightly gritty	210
Gray shale, marly	225
Gray shale	250
Gray shale	270
Gray shale	282
Black shale and coal	292
Gray shale	300
Gray shale	312
Gray shale, with small fragments of coal	325
Dark gray shale, with small white streaks, and slightly calcareous	345
Black shale, carbonaceous, and effervescing slightly with acid	350
Gray and dark gray fire clay in fragments showing many slickensides	370
Pennsylvanian-pre-Pennsylvanian contact.	
Gray shale with pyrite and coal, and white dolomitic limestone	388
Niagaran, 231 feet.	
White dolomitic limestone, granular under a lens. Much pyrite in minute spherules, probably from above	398
Dolomitic limestone, somewhat compact, of uniform texture and light-gray color	415
White dolomitic limestone with small grains of pyrite	422
Grayish white, dolomitic limestone, with a little white chert	435
White dolomite, porous, friable and having occasional small crevices lined with drusy, and chalcedonic quartz. Some white chert. Some rounded and finely polished grains of opalescent quartz occur in the sample and may or may not belong to the rock	450
Like the preceding, but with more chert. Some minute amber-colored spherules were noted in one fragment	470
White dolomite, soft and fine grained, with some fragments of quite clear quartz, opalescent. One fragment of white chert showed the structure of a minute favoritid coral or a bryozoan	480
Rock like the preceding	520
Porous dolomitic, soft and friable. Some fragments with a tinge of green. Some cavern clay and sand	540
Rock like that at 480 feet	555
Cream-white dolomitic limestone, soft and friable, with a little more chert than that at 480 feet	571
Limestone, like the preceding	578
Limestone, like the preceding	602
Niagaran, 248 feet.	
Porous, coarsely granular, straw-colored dolomitic limestone	608
Dolomitic limestone, straw-colored, of coarse granular texture, with occasional blotched dark fragments containing pyrite	615
Straw-colored, dolomitic limestone, compact with occasionally embedded white rock, and exhibiting traces of fossil forms	632
Dolomitic limestone, light gray, porous and coarse in texture	650
White dolomitic limestone of fine texture	673
Dolomitic limestone of light straw-color, and with stylolitic joints, stained dark	700
White dolomitic limestone of compact texture, effervescing with acid somewhat briskly for a dolomite	720
Dull, straw-gray, dolomitic limestone, porous and coarse	737
Dolomitic limestone with some green and some gray shale	765
Gray dolomitic limestone	787
White, compact, dolomitic limestone	800
White, compact, dolomitic limestone, with a little chert	815
White dolomitic limestone	820
White dolomitic limestone, with some white chert	842
Gray dolomitic limestone. The dark shade is due to exceedingly minute particles of pyrite	850
Cincinnatian, 170 feet.	
Clayey shale, greenish gray, effervescing slightly with acid	870
Like the preceding	905
Marly, gray shale	925
Marly, gray shale with much gray limestone in which bryozoa and joints of crinoid stems were noted	940
Marly, greenish gray shale	957
Like the preceding	970
Like the preceding	1,000
Like the preceding	1,020

Description of samples of drillings from well No. 2—Concluded.

	Depth in feet.
Galena-Trenton, 258 feet.	
Dirty, yellowish gray, dolomitic limestone	1,040
Dirty, yellowish gray, dolomitic limestone of coarse texture	1,055
Dirty, yellowish gray, dolomitic limestone of coarse texture, with some large and thin fragments of a greenish stony shale	1,080
Dolomitic limestone with shale, as above	1,100
Yellowish gray limestone and greenish stony shale as above, with an increased amount of the shale	1,120
Dolomitic limestone, straw-colored	1,175
Dolomitic limestone, straw-colored, very coarse in texture and in part very porous	1,245

NOTE.—The limestone extending for some 200 feet below the Pennsylvania series cannot be said to resemble very closely the Niagaran limestone as known from other borings in the northern part of the State. It has a more uniform texture than is usual and contains some quartz which is not all like the Niagarian chert, being clearer and more like some chalcedonic quartz common in the lower part of the Devonian on the Mississippi. On the basis of its dolomitic condition it should be referred to the Silurian, in the absence of any decisive evidence to the contrary. In texture the rock resembles the Devonian limestone lying under the Davenport quarry limestone on the Mississippi River.

9. WELL OF THE STATE ASYLUM FOR THE INSANE AT KANKAKEE, KANKAKEE COUNTY, ILLINOIS.

At the time this well was bored in 1908, Dr. H. F. Bain, then Director of The Illinois Geological Survey, made arrangements to obtain samples of the cuttings for the entire depth of the well. These were submitted in two lots: those from the upper 500 feet in 1908, and those from below this a year later. From the depth of 300 feet to 380 feet below the surface there were no samples. The rock in this interval was probably mostly shale. In taking samples, drillers frequently neglect soft shales, through which the work must proceed rapidly to prevent caving.

Description of samples from well at Kankakee, Illinois.

	Depth in feet.
Limestone, yellow, dolomitic, disintegrated	25
Limestone, soft, yellow	30
Limestone, dolomitic, disintegrated	40
Limestone, soft, yellow, disintegrated	45
Like the preceding	50
Limestone, dolomitic, grayish yellow	65
Limestone, dolomitic, gray, fine grained	70
Limestone, dolomitic, compact, gray, crystalline structure comparatively coarse	75
Limestone, dolomitic, gray, comparatively fine grained	85
Like the preceding	95
Like the preceding	100
Limestone, dolomitic, bluish white and fine in texture	105
Limestone, dolomitic, fine in texture, soft, gray	110
Limestone, dolomitic, gray	115
Limestone, dolomitic, gray, of fine texture	120
Like the preceding	125
Limestone, dolomitic, bluish gray, fine in texture	130
Limestone, dolomitic, white, soft	135
Limestone, dolomitic, white, soft, porous, fine grained	140
Limestone, dolomitic, light gray	145
Limestone, dolomitic, light gray	145
Limestone, dolomitic, white, fine grained	150
Limestone, dolomitic, white, fine grained	160
Limestone, dolomitic, gray	165
Limestone, dolomitic, light gray, fine grained	170

Descriptions of samples from well at Kankakee—Continued.

	Depth in feet.
Limestone, dolomitic, white	175
Limestone, dolomitic, white, porous	180
Limestone, dolomitic, almost white, of fine texture	185
Limestone, dolomitic, white, porous	190
Limestone, dolomitic, porous, of coarse texture	195
Limestone, dolomitic, white, porous, soft, fine in texture	235
Limestone, dolomitic, fine grained	240
Limestone, dolomitic, white, porous, coarse in texture	245
Limestone, dolomitic, white, porous, coarse in texture	255
Like the preceding	260
Limestone, dolomitic, white, soft, fine grained	265
Like the preceding	270
Like the preceding	290
Limestone, dolomitic, white, porous, fine grained	300
Shale, marly, gray	380
Shale, bluish gray	390
Shale, light gray, marly	400
Limestone, dolomitic, bluish white	405
Limestone, dolomitic, coarsely crystalline, grayish white, porous	415
Limestone, dolomitic, coarsely crystalline, straw-color, porous	425
Limestone, dolomitic, of dull straw-color, coarse in texture, porous	440
Limestone, dolomitic, of dull straw-color	445
Limestone, dolomitic, gray, coarsely crystalline	455
Limestone, dolomitic, of dull straw-color, and coarsely crystalline in texture	460
Limestone, dolomitic, of dull straw-color	465
Like the preceding	480
Limestone, dolomitic, of straw-color, porous, and coarsely crystalline	500
Limestone, dolomitic, gray, coarse texture	495
Finely ground dolomitic limestone	505
Gray, dolomitic limestone	510
White, dolomitic limestone of coarse texture. A small fragment of a shell was noted in one chip of the rock	515
Gray, dolomitic limestone	520
Gray, dolomitic limestone, porous and coarse in texture	525
Light gray, dolomitic limestone of coarse texture. Occasionally dark streaks were noted in some fragments	530
Light yellow gray, dolomitic limestone, coarse in texture	535
Gray, dolomitic limestone, of coarse texture	540
Dolomitic, gray limestone, with somewhat brisk effervescence for dolomite. A few black (bituminous) fragments were noted	545
Gray dolomitic limestone	550
Porous, rather light gray, dolomitic limestone of coarse texture	555
Gray, dolomitic limestone. A few green chips were noted	560
Gray, dolomitic limestone of coarse texture	565
Gray, dolomitic limestone with some dark blotches on the largest fragments	570
Light gray, dolomitic limestone of coarse texture. Some dark streaks were noted following the bedding planes	575
Light gray, dolomitic limestone. Some fragments were noted with faint dark streaks following the bedding planes	580
Gray, dolomitic limestone. Some coarsely crystalline fragments from cavernous openings showed free surfaces of black dolomitic crystals	585
Light gray, dolomitic limestone. A few dark fragments were noted	590
Gray, dolomitic limestone of coarse texture, with occasional dark blotches	595
Coarse grained, light gray, dolomitic limestone	600
Light gray, dolomitic limestone	605
Light gray, dolomitic limestone	610
Light gray, dolomitic limestone of moderately coarse texture, and with dark streaky blotches	615
Light gray, dolomitic limestone of somewhat fine texture. One fragment with a dark thin seam following the bedding plane	620
Light, dolomitic limestone. Some large chips of a dark straight-splitting shale, which did not effervesce with acid, were noted	625
Uniformly gray, fine grained, dolomitic limestone	630
Fine grained, gray, dolomitic limestone with two large lumps of a yellow crinoidal calcareous rock. Several crinoid fragments were noted, such as joints of stems, basals of a small calyx, etc. These were of a yellow color. They had evidently dropped down from the Niagara rock above	635
Light gray, coarse, dolomitic limestone. Some of the largest fragments were of a cream-color, and consisted of crinoid stem joints, arm pieces and one small base of a calyx. A few green, and one dark shaly pebble were noted	640
Gray, dolomitic limestone. One joint of a crinoid stem was noted and one large piece of rock showed a fossil like a *Polypora*	645
Gray, dolomitic limestone of fine texture	650
Gray, porous, dolomitic limestone	655
Yellowish gray, dolomitic limestone of somewhat coarse texture	660
Gray, dolomitic limestone	665
Gray, dolomitic limestone	670
Light gray, dolomitic limestone of coarse texture	675
Gray, dolomitic limestone. A few fragments were of a straw-color and of coarse texture	680

Descriptions of samples from well at Kankakee—Continued.

	Depth in feet.
Gray, dolomitic limestone. Some few fragments were white in color and calcareous, effervescing briskly. This sample also contained one drift pebble of diabase and one drift pebble of dolomitic limestone. There were also one joint of a crinoid stem, one fragment of gray chert and several lumps of a bluff, dolomitic, porous, limestone, resembling Le Claire rock, evidently from the Niagara	685
Dolomitic, gray limestone, with embedded dark grains. Several fragments of yellowish white porous crinoidal limestone effervescing briskly	690
Gray, dolomitic limestone	695
Darkish gray, dolomitic limestone	700
Some dark, some almost white, dolomitic limestone. The darker fragments shower black streaks following the bedding planes	705
Some dark, some light gray, dolomitic limestone. Some fragments with thin dark seams following the bedding planes	710
Gray, dolomitic limestone. One large broken and etched (?) fragment showed septae of a silicified cyathopyllid coral. This sample also contained one rounded pebble of hard yellow quartzite, no doubt a drift pebble	715
Gray, dolomitic limestone of fine texture	720
Fine grained, gray, dolomitic limestone of fine texture	725
Gray, dolomitic limestone of fine texture. Some light and yellowish fragments were present	735
Gray, dolomitic limestone of fine texture	740
Gray, dolomitic limestone of fine texture. Several yellow and porous fragments were noted. Some had drusy surfaces and these effervesced somewhat briskly. Two chert fragments and one of a brown dolomitic rock were noted	745
Gray, dolomitic limestone splitting in flakes. Some fragments were of a white, obscurely coarse granular and more calcareous rock	750
Gray, dolomitic limestone with some straw-colored fragments splitting in flakes	755
Darkish gray, dolomitic limestone. Many fragments with black material which appeared to follow joints in rock	760
Gray, dolomitic limestone. This sample contains, besides, one worn pebble of greenstone and one drift pebble of dolomite, and also a large fragment of a white, calcareous rock	765
Dark, dolomitic limestone splitting into thin flakes. In this sample was also some porous, brown, dolomitic rock, and one fragment of dark, dolomitic, limestone with embedded quartz grains	770
Gray, dolomitic limestone splitting into thin flakes. A few chips were somewhat shaly and greenish in color	775
Bluish gray, dolomitic limestone of fine texture	780
Dark, fine grained, dolomitic limestone	785
Fine grained, dark gray, dolomitic limestone	790
Mostly finely ground, yellow, and rusty flour of uniformly sized dolomitic crystals. It contained one large fragment of sandy dolomitic shale. There were also some chips of gray dolomitic limestone. (Sample small)	...
Mostly a yellow, rusty flour of dolomitic limestone. In this there was also one piece of flint, several fragments of gabbro from the drift, one pebble of quartzite, and several pieces of a yellow porous dolomitic rock of the Niagara. Some pieces of dolomitic limestone were lines with drusy quartz	800
Sample small, and consisting of a mixture of ground rock, drift clay, drift pebbles of diabase, and chert and rounded dolomite pebbles. There were also pulp and larger fragments of wood worn from the drill poles	805
Gray, dolomitic limestone. One fragment with an incrustation of pyrite. One fragment of yellow ocher	810
Gray, dolomitic limestone of fine texture	830
Gray, dolomitic limestone, somewhat porous	840
Gray, dolomitic limestone of fine texture, splitting into thin flakes. One small pebble of quartz and a large fragment of indurated and laminated shaly sandstone were noted	845
Gray, dolomitic limestone of fine texture. Some yellow white, porous, fragments were present, effervescing briskly, and some lumps of a greenish shale	850
Somewhat dark gray, dolomitic limestone of fine texture	855
Dark, dolomitic limestone of very fine texture, with small black blotches. There were also a few green flakes of shale	860
Dark gray, dolomitic limestone	865
Gray, dolomitic limestone. One large fragment was dark and impregnated with pyrite	870
Dark gray, dolomitic limestone of fine texture with darker blotches	875
Gray, dolomitic limestone with small dark blotches	880
Dark gray, dolomitic limestone of fine texture with dark blotchy streaks	885
Dark gray, dolomitic limestone, with embedded rounded coarse grains of quartz. Some few fragments of dark and dolomitic shale. Some dolomitic limestone without sand. One large fragment of white and porous dolomitic rock	890
Sandstone with a dolomitic intersticial matrix. Pyrite present, of a bright yellow color. Bulk of sand consists of grains measuring from .25 mm. to 1 mm. in diameter	895

Description of samples from well at Kankakee—Concluded.

	Depth in feet.
One-fourth of the sample consists of gray, dolomitic limestone. With this there were some pyrite, some crystals of calcite, and one joint of a crinoid stem, and some pieces of a pyritiferous green shale. Three-fourths of the sample consisted of quartz sand, showing many secondary crystal faces, the grains mostly from .25 mm. to 1 mm. in diameter	900
Sand of rounded quartz grains, showing secondary crystal faces, and the bulk measuring from .125 mm. to .5 mm. in diameter	925
Rounded quartz sand, most grains measuring from .125 mm. to .5 mm. in diameter. Some greenish pyrites were noted, and also some grains of chert and some fragments of a dark green shale	930
Rounded quartz sand, mostly measuring from .125 mm. to .5 mm. in diameter. There were also some fragments of concretions of pyrite with embedded grains of sand	935
Well rounded, white sand grains measuring mostly from .125 mm. to .75 mm. in diameter	940
Quartz sand with grains measuring mostly from .125 mm. to .5 m. in diameter, and showing some secondary crystal faces. There were several pieces of concretionary pyrite filling the interstices between the sand grains, and a few fragments of dolomitic limestone	945
Quartz sand of rounded grains varying in sizes from .125 mm. to .5 mm. in diameter	960
Quartz sand, bulk of grain measuring from .125 mm. to .5 mm. in diameter..	975
White quartz sand consisting of well rounded grains measuring mostly from .125 mm. to .5 mm. in diameter. One fragment of fine sandstone was slightly micaceous. There were some fragments of shale, and some of sandstone with a pyritic cement between the grains	990
Quartz sand, bulk of grains measuring from .125 mm. to .25 mm. in diameter. Some pyrite noted	1,005
Rounded quartz sand, with some secondary crystalline faces. Some pyrite noted	1,010
Rounded quartz sand, bulk of grains measuring from .125 mm. to .5 mm. in diameter. Most of the grains have secondary crystalline faces. One piece of dark shale was noted and there was one joint of a crinoid stem..	1,025
Quartz sand ranging in size mostly from .125 mm. to .25 mm. in diameter...	1,030
Rounded quartz sand with the bulk of the grains measuring from .125 mm. to .5 mm. in diameter	1,045
Rounded quartz sand with the bulk of the grains measuring from .125 mm. to .25 mm. in diameter	1,060
Quartz sand with many grains showing secondary crystal faces, and bulk of grains varying from .125 mm. to .5 mm. in diameter. Some pieces of concretions were noted, consisting of sand with intersticial pyrite	1,090

Summary interpretation of the above section.

	Thickness in feet.
(Niagara limestone). Dolomitic limestone, yellow, white, and gray	300
Cincinnatian shale	105
Galena-Trenton (upper part). Dolomitic limestone of mostly coarse texture and light color	355
Galena-Trenton (lower part). Dolomitic limestone of prevailing darker shale and finer texture	120
Dolomitic limestone, partly pure and partly containing embedded sand, with some green shale probably in separate seams. Beds of transition	15
(St. Peter sandstone). White, well worn quartz sand	190

The descriptions of the samples show some varying features, which may prove of value in correlating other records. Of these the following are of the most important.

The color of the limestone varies from almost white through light gray, yellowish gray, medium gray (designated as "gray") and dark gray to almost black. In the upper 250 feet of the Trenton-Galena series the prevailing shades are light gray and gray, whereas in the lower 120 feet of this formation, rock of a dark gray color is most common.

The crystalline grains in the dolomites vary considerably in size. In the coarse-grained samples the largest grains can readily be made out through a hand lens, since they average from two-tenths to three-tenths of a millimeter in diameter. For the samples in which the individual grains are barely visible under a hand lens no description has

been given, and for samples the texture of which is still more compact it is described as "fine" or "very fine." The examination of the samples shows that the upper two-thirds of the Galena-Trenton formation, which has a light color ,is coarser in texture than the lower and darker part. Rocks of fine texture are represented in the samples taken at the depths of 630 to 635, 650 to 655, 720 to 745, 770 to 805, 845 to 865, 875 to 885 feet.

Some of the dolomitic limestone shows small dark blotches. These are limited chiefly to two horizons: from 570 to 615 and from 860 to 885 feet below the surface. Blotched limestone was also noted in the samples from depths of 515, 545, and 690 feet. These are probably due to some slight impregnation of iron sulphide.

As a rule the limestones are not porous, excepting certain light calcareous fragments directly to be mentioned. The only samples of the main rock showing distinct minute porosites were from the depths of 525, 585, 655, and 840 feet. The sample from 840 feet was highly porous.

In the samples coming from depths greater than 500 feet were noted lumps of a white or light yellow rock with a subcrystalline structure which usually effervesces briskly with acid. The lumps were mingled with smaller fragments which represent the bulk of the Trenton rock. They are somewhat porous and in places exhibit drusy, free surfaces. Occasionally they contain crinoid fragments. It is well known that incrustations of calcite are common on the walls of cavities in dolomitic rock and evidently some of the lumps represent such incrustations in the Niagara rock which have fallen down from the upper part of the well. Some have the characteristic appearance of the Le Claire limestone and are dolomitic. This identification is corroborated by Dr. Stuart Weller, who has identified two of the crinoid fragments as *Pisocrinus,* which is characteristic of the Niagaran.

Some black thin incrustations, composed of manganese oxide, following joints in the rock were noted in the samples taken from depths of 530, 575, 620, 705, 710, and 760 feet. Pyrite was noted in the limestone from the depth of 879 feet and in the St. Peter sandstone in the samples taken from depths of 935, 945, 990, 1005, 1010, 1045, and 1090 feet. The pyrite occurring in the samples from 895 feet is yellow, almost like copper pyrite. The iron sulphide from the lower part of the St. Peter sandstone is marcasite and exists partly as minute crystalline spherules and partly as a cement between grains of sand.

Pebbles of gabbro, diabase, quartzite, chert, and dolomite were noted in several samples from 685 to 845 feet below the surface. These have, of course, fallen down from above.

The samples from the St. Peter sandstone were submitted to a rough mechanical analysis for the purpose of securing a permanent record of the size of the grains for this locality. It was found that the coarsest sand is in the upper part of the formation where the maximum ingredient is from one-fourth millimeter to one millimeter in diameter, whereas in the samples from a depth of 990 feet and more, the bulk of the sand grains measure from one-eighth to one-fourth of a millimeter.

Approximate mechanical analyses of the samples of St. Peter sandstone from Kankakee well. (In percentages by weight.)

Diameters of grains in millimeters.	Depth of samples, in feet.															
	895.	900.	925.	930.	935.	940.	945.	960.	975.	990.	1,005.	1,025.	1,030.	1,045.	1,060.	1,090.
2–1	tr.	....	....	....	....	....	....	....	....	....	.....	.....	.....	.....	.....	.....
1–½	10	70	1	3	5	10	tr.	tr.	tr.	tr.	tr.	2	3	tr.	1	.....
½–¼	80	15	35	62	60	40	40	40	32	26	10	30	15	20	30	36
¼–⅛	8	10	45	34	30	40	50	57	48	60	70	50	65	75	60	50
⅛ and less	2	5	19	1	5	10	10	3	20	14	20	18	17	5	9	14

The sizes of the sand grains in some of these samples must be somewhat in excess of the sizes represented in the original sediments. Originally the St. Peter sandstone consisted of thoroughly worn and rounded grains, but in five of the samples, those from the depths of 900, 925, 945, and 1,090 feet below the curb, a varying proportion of the grains show crystal faces, which are due to secondary growth. It appears that this growth has taken place in certain parts of the formation and not in other parts, owing probably to differences in the positions of the strata relative to the mineralizing solutions.

10. CITY WELL, HENRY, MARSHALL COUNTY.

The Henry city well was finished in September, 1886. A set of samples kept in the office of E. T. Disosway, at Henry, were examined by the writer in 1893, and another set kept by Joseph N. Krenz was examined in 1910. The two sets were practically identical.

Mr. Krenz also furnished some data, which he extracted from the minutes of the work, made in 1886. These notes are as follows:

"First 105 feet of hole has 8-inch pipe; next 150 feet has 6-inch pipe. Below 402 feet a 3.5-inch pipe was used. From 135 to 402 feet the well was in shale. The contract for the making of the well was given by the city to Wm. H. Gray, of Chicago. The first flow of water, 15 gallons per minute, was obtained at a depth of 548 feet. At 675 feet there was a flow of 60 gallons per minute; at 800 feet, a flow of 66 gallons; at 1,118 feet, a flow of unknown amount; at 1,200 feet a flow of

113 gallons; at 1,250 feet, one of 175 gallons, and at 1,355 feet, an additional flow of 325 gallons." The water still flows. It is now used for public fountains, for baths, and for sprinkling.

Description of samples from Henry city well, Illinois.

	Depth in feet. From.	To.
Sand and gravelly soil	..	4
Gravel, 1 to 10 mm. in diameter	4	13
Gravel, 2 to 5 mm. in diameter	13	28
Clean sand	28	31
Gravel and sand	31	53
Gravel, with calcareous silt	53	56
Gravel, sand and calcareous silt	56	70
Gravel, 3 to 8 mm. in diameter	70	75
Clean sand	75	82
Gravel and sand	82	85
Clean coarse sand	85	102
Blue clayey silt, as coarse as loess, not calcareous	102	135
Dark shale, partly black, with some calcareous material	135	150
Fire clay, bluish gray	150	180
Gray shale, with some calcareous material, and some pyrite	180	220
Somewhat dark gray, clayey shale, with calcareous concretionary material that contains zinc blende, with some pyrite	220	245
Mottled dark gray shale of fine texture, not calcareous	245	325
A sample consisting of three kinds of material: 1. A green unctuous clay, shale or fire clay. 2. A black shale, almost coaly. 3. A faintly brownish gray shale, indistinctly micaceous, and containing *Sporangites huronense* in abundance. The sample contains more shale of the last kind than of either of the other two. The last mentioned shale is Devonian, the other two Pennsylvanian	325	402
Mostly white, finely granular limestone, effervescing somewhat slowly for a calcareous rock, also black calcareous limestone, some black shale, some green shale, some crystalline calcite, and much pyrite. One fragment noted consisted of brown colitic spherules 1 mm. in diameter. *Sporangites huronense* noted, also a fragment of a fossil resembling the attenuated apex of a pteropod shell. This sample is believed to be Devonian limestone and shale	402	426
One large fragment of mottled green gray, calcareous and soft limestone, studded profusely with small grains of pyrite. Most of sample consists of white calcareous limestone of fine texture, evidently Devonian, and gray dolomitic limestone, no doubt Niagara	426	485
Dolomitic limestone of fine texture and light cream-color	485	490
Dolomitic limestone of light cream-color and fine texture	490	500
Dolomitic limestone of light dirty yellowish color, with white chert and green cavern clay. Also some dark gray dolomite	500	535
Dolomitic limestone, cream-colored, with some greenish fragments	535	540
Dolomitic limestone, yellowish gray and finely porous	540	550
Dolomitic, cream-colored limestone, with some shale having alternate thin layers of green and dark, purplish material. This shale does not effervesce with acid	550	630
Dolomitic limestone, yellowish white, of compact even texture	630	750
Like the preceding	750	800
Dolomitic limestone, slightly yellowish white, of fine texture, with a few fragments of slightly porous texture	800	850
Dolomitic limestone of fine texture, in part pure white	850	880
Light gray dolomitic limestone of moderately fine but porous texture	880	890
White and gray dolomitic limestone of slightly open texture	890	905
Gray dolomitic limestone	905	935
Mostly a very fiine-grained, bluish gray, siliceous sandstone with a dolomitic matrix, sand grains measuring about .04 mm. in diameter. The rock is studded with black specks or grains of pyrite, apparently slightly smaller than the quartz grains	935	965
Bluish light gray calcareous shale, with fragments of rock like that in the preceding sample. Also some fossil-bearing shaly limestone	965	1,040
Dolomitic gray limestone and dark gray shale	1,040	1,100
Dark gray shale and cream gray dolomitic limestone	1,100	1,200
Cream-colored, dolomitic limestone, with some green shale in large fragments	1,200	1,345
Some dark gray and some brownish black and shaly dolomitic limestone	1,345	1,355

From the surface to 135 feet is drift. From 135 feet below the surface to some point between 325 and 402 feet is Pennsylvanian. From some point above 402 to or a little below this figure is Sweetland Creek shale of the Devonian. Below the Sweetland Creek shale there is some

Devonian limestone, probably some 50 feet. The top of the Niagara limestone lies higher than 485 feet below the surface, and extends down to 935 feet. From 935 to 1,100 feet is mostly and probably all, Cincinnatian. The remainder is probably all Galena.

11 AND 12. PRINCETON CITY WELLS, PRINCETON, BUREAU COUNTY.

In 1889 the city of Princeton completed a deep well for the purpose of securing a supply of water, and in the summer of 1892 the writer made a visit to the city to obtain data upon it. The well is located southwest of the intersection of North and Main streets. The engineer at the city water works states that the well was cased to a depth of 400 feet, and that the water at first rose to within 50 feet of the curb of the well, but that it was pumped from a depth of 130 feet in 1892. By aneroid measurement, checked to the level of the Chicago, Burlington and Quincy Railroad depot, the elevation of the curb was made out to be 700 feet above sea level. A hasty examination was made of some samples of the drillings, in the possession of Mr. Jacob Miller, President of the Princeton Academy of Science, who furnished a record of the strata penetrated in the well. The driller's record was as below:

Record of the city well drilled at Princeton, Illinois.

	Thickness in feet.
Clay	182
Quicksand	8
Clay	30
Quicksand	320
Shale	190
Limestone	385
Shale	15
Limestone mixed with shale	20
Limestone	15
Shale	25
Limestone	120
Limestone mixed with shale	20
Limestone	70
Limestone mixed with sand	60
Quicksand	20
"Limestone, Trenton"	220
"St. Peter sandstone"	160
"Calciferous"	785

A few years later a second well was drilled a short distance east of the first well. The driller's record of this well is as below:

Record of second city well drilled at Princeton, Illinois.

	Depth in feet. From.	To.
Clay	0	47
Sand and gravel	47	57
Hardpan	57	145
Sand and gravel	145	150
Hardpan	150	175
Sand and gravel with hard streaks	175	372
Slate	372	447
Limestone	447	655
Slate	655	660
Limestone	660	1,037

feet; the third flow, amounting to 75 gallons a minute, came at a depth of 1,400 feet, and the fourth flow was from a depth of 1,640 feet. This increased the total flow of the well to 200 gallons a minute. The salinity of the water increased below this depth and for this reason the drilling ceased at 2,252 feet. Mr. D. M. Stamm, of Geneseo, made an analysis of the water before 1892, and this gave the following results in grains per U. S. gallon:

Analysis of water from well at Geneseo, Illinois.

[In grains per U. S. gallon of 231 cubic inches.]

Sodium chloride ($NaCl$)	90.403
Sodium sulphate (Na_2SO_4)	11.340
Calcium sulphate ($CaSO_4$)	24.105
Calcium carbonate ($CaCO_3$)	4.583
Magnesium carbonate ($MgCO_3$)	10.231
Ferrous carbonate ($FeCO_3$)	.200
Alumina (Al_2O_3)	1.806
Silica (SiO_2)	8.550
Carbon dioxide (CO_2)	6.497

The temperature of the water flowing in 1892 was 65° F.

The same year a set of drillings, kept by the city engineer, was examined by the writer and the following notes were made:

Description of samples from well at Geneseo, Illinois.

	Depth in feet.
Black shale	100
White limestone (Devonian)	122
Limestone (recognized as Niagaran)	220
Limestone (recognized as Niagaran)	320
Limestone (recognized as Niagaran)	420
Shale	600
Shale, with some fragments of limestone	650
Marly material and pulverized limestone	700
Limestone, with some fragments of shale	900
Limestone	950
Limestone	1,000
White sand, fine in texture	1,075
Dark, greenish-blue shale	1,115
Sandstone, recognized as St. Peter	1,125
Greenish shale	1,185
White sand, with some rusty grains	1,205
White sand mixed with white limestone	1,240
Sand, with some brown grains	2,090
Rose-colored sand, with some brown grains and some green grains	2,225

A record of the strata of this well was published in The Geneseo News for August 18, 1887, and a copy of this record was obtained in 1910 and is, with the writer's interpretation of the record and the samples, as below:

Interpretation of record of well at Geneseo, Illinois.

	Thickness in feet.	Depth in feet.
Pleistocene, drift, 42 feet.		
Blue clay	35	35
Sand and gravel	35	35
Pennsylvanian, "Coal Measures," 82 feet.		
Blue shale	38	80
Blue limestone	4	84
Black shale	40	124
Silurian, Niagaran (perhaps with some Devonian), 426 feet.		
Gray limestone	426	550

Interpretation of record of well at Geneseo—Concluded.

	Thickness in feet.	Depth in feet.
Ordovician, Cincinnatian, 95 feet.		
Blue shale	95	645
Ordovician, Galena-Trenton, 430 feet.		
White limestone	430	1,075
Ordovician, St. Peter, 115 feet.		
NOTE.—Water began to flow here, 35 gallons per minute.		
Sandstone	35	1,110
Blue shale	5	1,115
Sandstone	67	1,182
Blue shale	8	1,190
Ordovician, Oneota, 845 feet.		
Sandstone mixed with limestone	410	1,600
NOTE.—Big flow struck here, 200 gallons in 1 minute and 10 second.		
Limestone	435	2,035
Cambrian, Potsdam, 215 feet.		
Sandstone	125	2,160
Limestone	25	2,185
Red shale	30	2,215
Red sand	10	2,225
Limestone	25	2,250

14. WELL OF MODERN WOODMEN OF AMERICA, ROCK ISLAND, ROCK ISLAND COUNTY.

The Modern Woodmen of America drilled an artesian well near the main office in Rock Island, Ill. in June and July, 1909. A description of samples taken by the drillers is as below:

Record of well at Rock Island, Illinois.

	Depth below curb in feet.
Dolomitic cream-colored limestone	165
Dolomitic limestone, porous	180
Dolomitic limestone, white, cavernous	195
Dolomitic limestone, coarsely granular, white, with some dark, compact and pyritiferous dolomite, and two large fragments of sandstone	225
Dolomitic limestone, coarsely crystalline, white, with some lumps of green clay	245
Like the above	260
Dolomitic limestone, white, coarse	275
Dolomitic limestone, white, porous, coarse	290
Like the above	305
Dolomitic limestone, white, coarsely crystalline, porous, with cavities from dissolved joints of crinoid stems	320
Dolomitic limestone, porous and coarse	330
Like the preceding	345
Dolomitic limestone, white	360
Like the preceding	380
Dolomitic limestone, gray, with a few fragments of white chert	405
Shale, light gray, effervesces with acid	420
Like the preceding	440
Shale, light gray, with fragments of a dolomitic limestone having streaks of a black pyritiferous material, spherical clusters of cubic crystals of pyrite and a minute bryozoan	465
Like the preceding, except that the black material in the limestone is in minute specks. Bryozoa noted	480
Shale, slightly silty, with fragments of limestone streaked with black; occasional grains of quartz and pyrite present, but less than in preceding sample	500
Like the preceding, with small spherules of pyrite	515
Like the preceding, with a small bryozoan or a favositid with small polyps and a flat corallum	525
Shaly limestone, gray, dolomitic, with some flaky shale	550
Greenish gray clay, effervescence with acid hardly perceptible	567
Dolomitic limestone, dark gray, fine grained	582
Shale, dark gray, bituminous in appearance	600
Dark shale, almost black when wet	620
Dolomitic limestone, rusty gray	635
Like the preceding	655
Dolomitic limestone, rusty yellowish gray, coarse in texture	670
Dolomitic limestone, faintly yellowish gray	685
Like the preceding	705

Record of well at Rock Island—Concluded.

	Depth below curb in feet.
Like the preceding	720
Dolomitic limestone, lighter	735
Like the preceding	750
Dolomitic limestone, yellowish gray, with a few small white fragments of chert	765
Like the preceding, with some white fragments of dolomite	780
Dolomite limestone, yellowish with some small fragments of white chert	810
Dolomite limestone, straw-colored	835
Like the preceding	850
Dolomitic limestone, of a rusty color	865
Limestone, gray, not dolomitic	880
Like the preceding	895
Limestone, calcareous, gray with one lump of sandstone	905
Limestone, gray, calcareous	920
Like the preceding	935
Limestone, gray, effervesces briskly; with minute black specks, and small crystals of pyrite	950
Sand, of rounded, clear quartz grains, rather small	965
Greenish gray shale	980
Sand, coarse rounded grains; with some thin fragments of a stiff green shale	1,005
Clean quartz sand	1,020
Like the preceding, but coarser	1,035
Like the preceding	1,055
Quartz sand, cream-colored, of somewhat fine texture	1,070
Quartz sand, yellowish, fine in texture	1,080
Like the preceding, slightly finer in texture	1,110
Green shale	1,123

No samples were seen from the uppermost 160 feet of this well, but from other wells drilled in the city and from outcrops of rock in the immediate vicinity it is known that its uppermost sixty feet are in Devonian limestone. This is underlain by 360 feet of Niagaran limestone. The shale and included limestone below this to a depth of 620 feet is the Cincinnati formation. The Galena limestone, which is dolomitic, extends from 620 to 880 feet, and under this there are 85 feet of Trenton limestone, which is calcareous. The lowermost 160 feet consist of the St. Peter sandstone and its associated shales.

15. OLD CITY WELL, MONMOUTH, WARREN COUNTY.

This well is located at No. 410 N. Sixth Street. It is the first deep well made in Monmouth, and was begun in 1887. Drillings were taken at intervals of from five to twenty feet, and a report of the strata, based on an examination of these samples, was made by Prof. J. H. Southwell, and published on p. 66, Vol. VIII of the Geological Survey of Illinois. This report is as follows:

Geologic section of well at Monmouth.

	Thickness in feet.	Depth in feet.
Drift, clay	67	67
"Coal Measure" shale	5	72
Burlington limestone	96	166
Kinderhook shale	124	292
Devonian shale and limestone	109	401
Niagara limestone	68	469
Cincinnati shale	83	552
Trenton limestone	526	1,078
St. Peter sandstone	154	1,232

In 1910 the writer procured sub-samples from the set of samples which were taken when the well was made and were still preserved. Below is a detailed description of these samples, with the writer's determinations of the formations represented.

Descriptions of samples from old city well at Monmouth, Illinois.

	Thickness in feet.	Depth in feet.
Drift, 53 feet.		
Loess soil	2	2
Boulder clay	12	14
Yellow sand	4	18
Yellow silt	16	37
Boulder clay	3	40
Yellow sand and gravel	16	53
"Coal Measures," 19 feet.		
Soft shale	14	67
Gray shale	5	72
Burlington limestone, 96 feet.		
Gray calcareous limestone with chert and occasional crinoid stems, seen in nine successive samples	83	155
Dolomitic, porous limestone	5	160
Dolomitic limestone, with chert	8	168
Kinderhook shale, 122 feet.		
Greenish gray shale with crinoid stems and pyrite (2 samples)	15	183
Greenish gray shale, (2 samples)	11	194
Greenish shale, with pyrite	6	200
Greenish gray shale (3 samples)	15	215
Greenish gray shale, with calcareous fragments (2 samples)	10	225
Greenish gray shale (6 samples)	37	262
Greenish gray shale with crinoid fragments	5	267
Greenish gray shale (3 samples)	23	290
Devonian (Sweetland Creek) shale, 154 feet.		
Dark gray shale	9	299
Black, or dark gray, shale containing *Sporangites huronense* and denticles of annelids (?)	14	313
Gray shale, containing *Sporangites huronense* (12 samples)	79	392
Dark gray shale, with *Sporangites huronense* and spherical concretions of pyrite ⅛-in. in diameter	5	397
Gray shale with *Sporangites huronense* (4 samples)	32	429
Dolomitic, finely granular rock, resembling the lower stony layers of the Sweetland Creek beds (2 samples). There were also noted some shale, some octahedral crystals of pyrite, several joints of crinoid stems and one crinoid plate	15	444
Devonian (Cedar Valley) limestone, 78 feet.		
Calcareous limestone with pyrite and crinoid stems, mixed with some material like that in the previous sample (2 samples)	10	454
Mainly calcareous limestone, mixed with shaly material. Pyrite present. *Chetetes* (?) noted. A few grains of intensely green color. Some limestone fragments show minute grains of a black substance which does not effervesce with acid (bituminous?). Some green shale of very fine texture, and some calcite crystals	18	472
Calcareous limestone	6	478
Gray shale, stony and with fragments of fossils	5	483
Gray, calcareous limestone, with some shale, and some fragments of limestone with black grains, and with occasional fragments of shells and of bryozoa (7 samples)	(?)4 30	(?)487 517
White, brittle, compact, calcareous limestone, like the rock in in the lowest Devonian at Rock Island	5	522
Silurian (Niagaran) limestone, 58 feet.		
Gray, blotched and compact, dolomitic limestone (3 samples)	16	538
Gray dolomitic limestone (2 samples)	10	548
Light gray dolomitic limestone (6 samples)	32	580
Ordovician (Cincinnatian) shale, 81 feet.		
Bluish gray shale, with pyrite in uppermost sample (6 samples)	31	611
Dark gray shale, with sperical concretions of pyrite and a few fragments of black, bituminous, calcareous limestone	5	676
Gray shale, one sample giving slow effervescence with acid (6 samples)	38	654
Dark gray, granular shale	7	661
Ordovician (Galena-Trenton) limestone, 413 feet.		
Gray dolomitic limestone (5 samples)	27	688
Dark shaly dolomitic rock, falling into fragments in acid (2 samples)	10	698

Descriptions of samples from old city well at Monmouth—Concluded.

	Thickness in feet.	Depth in feet.
Ordovician (Galena-Trenton) limestone, 413 feet—Concluded.		
Dark gray, dolomitic limestone (7 samples)	39	737
Greenish gray, shaly, dolomitic limestone	9	746
Dolomitic limestone, dark gray (3 samples)	19	765
Dolomitic limestone, some gray, some straw-color, and some greenish; with some pyrite (2 samples)	15	780
Dull straw-colored, dolomitic limestone (13 samples)	75	855
Dull straw-colored, dolomitic limestone with some green shale (2 samples)	9	864
Straw-colored, dolomitic limestone (3 samples)	12	876
Cream-colored, dolomitic limestone, with some white chert (2 samples)	14	890
Cream-colored, dolomitic limestone (2 samples)	5	895
Green shale	5	900
Cream-colored, dolomitic limestone	4	904
Cream-colored, dolomitic limestone with some shale and some chert. The shale is associated with limestone, alternating with it in thin layers	31	935
Cream-colored, dolomitic limestone; in middle sample porous (3 samples)	37	972
Cream-colored, dolomitic limestone, with pyrite and shale	20	992
Cream-colored, dolomitic limestone, with some shale	12	1,004
Cream-colored, dolomitic limestone, with fragments of a black rock containing a high percent of bitumen, possibly 50 per cent	11	1,015
Cream-colored, dolomitic limestone with a little chert	7	1,022
Dull brown, dolomitic limestone with some chert and some green shale	13	1,035
Gray, dolomitic limestone with chert of the same color	15	1,050
Dull straw-colored, dolomitic limestone, with some white calcareous limestone	3	1,053
Dull straw-colored, calcareous limestone	7	1,060
Gray limestone, somewhat dolomitic	9	1,069
Gray, dolomitic limestone, with some green shale marked by foliated black blotches	5	1,074
Ordovician (St. Peter) sandstone, 156 feet.		
Coarse rounded quartz sand with about half of the grains having secondary crystalline growth	9	1,083
Rounded quartz sand (10 samples)	59	1,142
Rounded quartz sand, finer in texture (5 samples)	35	1,177
Somewhat coarse, rounded quartz sand	7	1,184
Medium fine rounded quartz sand (4 samples)	29	1,213
Moderately coarse quartz sand and green shale	5	1,218
Coarse rounded quartz sand	3	1,221
Fine quartz sand	4	1,225
Coarse sand and green shale	5	1,230
Ordovician (Lower Magnesian) limestone, 2 feet.		
White dolomitic limestone with some sand	2	1,232

The above record of the formations made out from the drillings must be regarded as one of the most satisfactory records from any boring of equal depth in the State. It shows that the Niagaran limestone has a much smaller thickness than it has farther north or farther east. This is due probably to pre-Devonian erosion. The shale between the Burlington and the Cedar Valley limestones exhibits two divisions: a lower darker part which contains *Sporangites huronense* throughout its entire thickness, and which, without a doubt, is the equivalent of the Sweetland Creek shale in Iowa, and a lighter, upper part which is destitute, so far as observed, of *Sporangites,* and which probably is the equivalent of the Kinderhook shales at Burlington in Iowa. These two shales may be unconformable.

16. CITY WELL, NO. 3, GALESBURG, KNOX COUNTY.

Well No. 3 of the city waterworks of Galesburg is located about 420 feet southeast of the crossing of Main and Henderson streets. Samples

were taken from this well to represent each separate formation penetrated, and sub-samples from these were submitted to the writer in the spring of 1910, by Mr. F. N. Conolly, the city engineer, three years after the well was made. W. H. Gray & Bros., of Chicago, were the contractors. Work was begun on July 27, 1906, and the well was completed the following year. The elevation of the curb of the well is about 750 feet above sea level. Its diameter is sixteen inches at the top of the well and eight inches at its bottom. A 16-inch casing extends down 81 feet; a 12-inch extends 257 feet farther; a 10-inch extends 42 feet; and an 8-inch extends 410 feet. The water does not flow, and when highest it stands 160 feet from the surface. Air-lift is used for pumping and the maximum yield is 160 gallons per minute. The principal water bed is at 1,080 feet below the surface. The descriptions of the samples submitted are as follows:

Description of samples from well No. 3,, Galesburg, Illinois.

	Depth in feet.	Thickness in feet.
Black loam	4	4
Loess, showing tubular penetrations from roots of vegetation	12	8
Clayey sand	30	18
Sand	50	20
Clean sand and gravel	75	25
Shale, dark	83	8
Black coaly shale, with shaly coal	85	2
Light gray fire clay, with some small fragments of coal	100	15
Gray, sandy limestone	140	40
Grayish white shale	175	30
Gray shale of the "Coal Measures"	200	25
Dark gray shale of the "Coal Measures"	230	30
Light, bluish-gray, unctuous shale, into which have been worked small splinters of a white chert such as is found in the Burlington limestone	245	15
Gray shale containing *Sporangites huronense* in abundance. The specimen is labeled "brown shale"	330	85
Dolomitic, shaly limestone of gray color (Devonian)	380	50
White, dolomitic limestone of coarse crystalline texture (Niagaran)	550	170
Gray shale	650	100
Gray, fine-grained, dolomitic limestone	680	30
Gray shale. The original label reads: "Brown shale"	750	70
Yellowish gray, dolomitic limestone	*370	*750
Sandstone (St. Peter)	1,100	30
Coarse, clean, quartz sand	1,150	50
Coarse, clean, quartz sand	1,170	20
Fine, clean, quartz sand	1,215	45

The chert fragments in the sample of shale at the depth of 245 feet indicates the presence of a remnant of the chert of the Burlington limestone at the unconformity below the base of the "Coal Measures." The record of Galesburg city well, No. 1 shows, at about the same level, fifteen feet of "limestone and flint," which presumably is a thicker remnant of the same formation, and which corroborates the inference stated as to the source of this chert in the clay in well No. 3. The writer's inter-

*Evidently wrong.

pretation of the formations represented by the samples submitted is as follows:

Formations represented by the samples of drillings from the Galesburg well No. 3.

	Thickness in feet.
Pleistocene	75
Pennsylvanian	165
Remnant of Mississippian cherts	Small
Sweetland Creek, Devonian shale	90
Devonian limestone	50
Niagaran limestone	160
Cincinnatian shale	200
Galena and Trenton limestone	350

17. WELL ON W. B. MANLOVE'S FARM, BIRMINGHAM TOWNSHIP, SCHUYLER COUNTY.

The Schuyler Oil and Gas Company made a well in 1909 on the farm belonging to W. B. Manlove, located in Birmingham Township, Schuyler County, about four miles southeast of the town of Plymouth. Samples of the drillings from this well were submitted to the writer by Mr. J. E. Wilson, the contractor.

In a letter dated May 26, 1909, at Plymouth, Ill., Mr. Wilson wrote as follows: "On account of caving we have had to abandon this well at 1,125 feet, but will drill again at once. After passing through about 420 feet of blue shale, we struck limestone, drilled through that about 230 feet. Then we struck sandstone and have drilled in that about 230 feet. When we struck this sandstone we got a flood of water. It came to the top and ran out, and has increased in volume till it now runs 45 gallons per minute. We have piped it twenty feet above the top and the force does not seem to be diminished.

Some of the samples may not be marked just right, as I had to rely on my men during my absence from the work." (Signed) J. E. Wilson.

The samples referred to were examined by the writer. They are described below:

Description of samples from the Manlove well Schuyler County, Illinois.

	Depth in feet.
Crinoidal calcareous limestone, with much chert, which is filled with fragments of fossils, mainly bryozoa and brachiopoda. The chert is opalescent white	50
Like the preceding. One fragment contained light green particles	60
Mostly nonfossiliferous white chert, with which there is some dolomitic limestone. There were two fragments of chalcedonic geodes, with drusy interior surfaces, and measuring about one-third inch and two-third inch in diameter	70
Chert and dolomitic limestone of a dirty straw-color	80
White calcareous limestone, with chert having the structure of an organic breecia	90
White calcareous limestone with about one-tenth of its mass chert, which shows organic structure	200
White calcareous limestone, with somewhat more chert of the same kind	220

Description of samples from the Manlove well—Concluded.

	Depth in feet.
Pure white, mainly crinoidal limestone, and almost without chert	235
Light shale, with fragment of limestone	246
Light blue shale, with much pyrite in small crystals. Fragments of calcareous limestone frequent	280
Light blue shale, with pyrite and calcareous fragments	292
Light, greenish blue shale with pyrite	295
Light, greenish blue shale, with only infrequent crystals of pyrite	302
Light, greenish blue shale. No pyrite noted	302
Light, greenish blue shale	310
Light, greenish blue shale	320
Greenish gray shale, with poorly preserved specimens of *Sporangites* occurring sparsely	330
Greenish gray shale, with *Sporangites*	340
Greenish gray shale, with poorly preserved specimens of *Sporangites*	345
Gray shale, faintly micaceous, with *Sporangites*	355
Gray shale, with abundant *Sporangites*, and occasional crystals of pyrite	365
Gray shale, with *Sporangites* poorly preserved	400
Light gray shale, micaceous, with comparatively thick specimens of *Sporangites*, and shapeless fragments of resinous material which appear to be shreds of *Sporangites*	415
Shale, almost black, showing reflections of minute scales of mica. A highly bituminous rock which burns for a few moments after it has been thoroughly ignited. On the split surfaces of some large fragments several small specimens of *Lingula* were noted, about 1 mm. in diameter. The distance from the umbo to the ventral margin of the valves was slightly greater than the transverse measure. Faint lines radiate from the umbo, and distinct concentric lines of growth are present. Irregular minute tubercles appear on the outer part of the valves. This black shale as a yellow translucent mass in transmitted light under the lens	511
A highly bituminous limestone, most of which effervesces briskly with acid. Some effervesces hardly at all. Some of the sample is crystalline calcite, and some bituminous fragments when ignited burn for a few seconds. The label on the sample was blurred, 5?1, but its highly bituminous character makes it probable that it is from about the same depth as the previous sample	±511
Green clay shale, not effervescing in acid	600
Greenish gray shale, of very fine plastic texture, effervescing slightly with acid. Contains a valve of an *Estheria?* Label indistinct: 680 or 683	683
White calcareous limestone with embedded minute fragments of fossils, making an organic fragmental rock	685
White calcareous soft limestone. A loosely cemented breccia of minute organic fragments. Presence of Foraminifera problematic	710
Like the preceding	730
White, soft, calcareous limestone, with thin sinuous films of black bituminous material. Emitting bituminous odor before the blowpipe	750
Calcareous limestone, slightly bituminous, composed of calcite crystals. Some fragments consist of a rock like that seen in the two previous samples. They probably fell down from upper levels	800
White limestone with some white chert, which is full of fossil fragments, like the chert from the Mississippian limestone. It is possible that the label on this sample is wrong	850
Dark limestone, black when wet, with minute specks of bituminous matter. Resembles the shaly limestone of the Cedar Valley in Iowa	930
Yellowish gray, calcareous limestone, possibly an equivalent to the Davenport quarry beds of the Devonian in Iowa	950
Gray quartz sand, mixed with some fragments of calcareous limestone and rare fragments of dolomitic limestone. The sample has the dirty appearance of "oil-sand." No bituminous odor was detected on heating in an open tube. Label wrong?	955
White quartz sand, with a few small flakes of a thinly laminated rock. Like St. Peter sandstone in general appearance	958
Light gray quartz sand, grains rounded and moderately coarse	1,125

A sandstone with water was reported as occurring in the well at a depth of from 140 to 160 feet.

With the uncertainty of the labels mentioned by the contractor in his letter of May 26, 1909, and with a slight disagreement of some of the labels on the samples with the depths of the formations furnished in the same letter, no very accurate section of the strata penetrated by this well can be made. Nevertheless the record settles several points with regard to the stratigraphy in this region. The limestone extending down to 240 feet below the surface is clearly of Mississippian age. The

shale underlying this limestone to the depth of some 680 feet is the equivalent of the Kinderhook shale at Burlington and of the Sweetland Creek shale of the Devonian farther north on the Mississippi. The combined thickness of the two shales in this well is near 450 feet, which is only about 100 feet more than the thickness known from other explorations. The limestone shown in samples from depths between 685 and 950 feet, is certainly neither Silurian nor Ordovician. If the samples of cuttings have been taken from the depths stated, this limestone must be in the main of Devonian age, which, to judge from the last two samples taken, here rests on the St. Peter sandstone. If this is correct, it indicates the present of an anticline, the crest of which must have been reduced by several hundred feet before the deposition of the Devonian limestone. While a buried anticline of this kind is indicated by other explorations along the Mississippi River, a certain interpretation of this part of the stratigraphic record must await further and more carefully procured data. The following is the writer's tentative interpretation:

Interpretation of record of Manlove well, Schuyler County, Illinois.

	Depth in feet. From.	To.
Drift	0	30
Mississippian limestone	30	240
Kinderhook and Devonian shales	240	690
Devonian limestone (with some Trenton limestone below?)	690	960
St. Peter sandstone	960	1,135

18. WELL ON THE M'GINNIS FARM, NEAR JACKSONVILLE, MORGAN COUNTY.

In August, 1910, samples of drillings were submitted to the writer by Mr. R. S. Blatchley of the Illinois State Geological Survey, from a well being drilled on the SW. ¼ sec. 33, T. 15 N., R. 9 W., on the McGinnis farm near Jacksonville. The samples were taken mostly at intervals of 5 feet and represented the strata explored from 310 to 380 feet below the surface. All the rock is limestone, mostly calcareous, some dolomitic, some containing fine sand, and some with oolitic spherules. It represents the upper part of the Mississippian series, probably the St. Louis.

Description of samples from well near Jacksonville, Illinois.

	Depth in feet.
White calcareous limestone, consisting of a mixture of minute (organic) fragments exhibiting a finely reticulated texture as seen on a polished surface. Some fragments showed thin dark layers with minute crystals of marcasite	310
Grayish white limestone. Some fragments consisted of oolite, with spherules about .5 mm. in diameter. Some showed minute crystals and specks of marcasite	315
Gray dolomitic limestone of very finely granular texture, with embedded small quartz grains, and with occasional bright grains of green. Some broken minute spines were noted, and there were some fragments of dark or black shale	320

Description of samples from well near Jacksonville—Concluded.

	Depth in feet.
Limestone, somewhat slowly effervescent with acid, of very minute granular texture, and containing some very minute quartz grains. Color, gray to white. A bright green mineral was noted, lining the surface of a cavity. There were a few fragments of shale, some gray, some greenish gray.....	325
Like the preceding, with some calcareous limestone, and with more shale, some of which is streaky with dark and light gray layers.....	330
Compact limestone, dove-colored	335
Like the preceding	340
Compact limestone, with greenish and dark shale	345
Gray limestone, composed of organic fragmental material with bryozoa, crinoid remains, etc.	350
Limestone, white, pure, and quite compact, with occasional spherules, .5 to 1 mm. in diameter, probably oolitic. Small spheroidal aggregations of marcasite, and some gray shale	355
Limestone, some light gray, some white, with some little shale. The limestone contains fine quartz sand, the grains ranging from .06 mm. to .25 mm. in diameter. Gypsum, as selemite and in spheroid concretions, was noted, also spherules of marcasite and some fragments of a green mineral.....	360
Limestone, calcareous, light gray, with embedded fine sand, as in layer above	370
Gray limestone, in part magnesian and in part calcareous, with one fragment of sandstone cemented with a calcareous matrix and some shale in large lumps. Marcasite in small granules also present.....	380

19. CHICAGO, WILMINGTON AND VERMILION COAL COMPANY'S TEST HOLE, THAYER, SANGAMON COUNTY.

This boring was completed in the last part of 1908 to the depth of 635 feet. The writer is ignorant as to whether the work continued to any greater depth. Samples were submitted for examination taken at depths indicated in some cases by two numbers, in other cases by only one. In cases where only one number is given this evidently denotes the depth of the well at the time the sample was taken.

All of the samples are apparently from the Pennsylvanian series.

Description of samples from test hole at Thayer, Illinois.

	Depth in feet. From.	To.
Shale and some drift pebbles	45	55
Limestone, of concretionary appearance	55	65
Gray sandy shale	...	70
Gray sandy shale	75	83
Gray micaceous shale	...	95
Micaceous silty shale	95	105
Gray sandy shale	105	115
Gray shale	115	125
Gray shale, with some calcareous fragments. On the label is the note: "Coal, 8 inches"	125	135
Gray and partly dark limestone, with pyrite, some coal and some black shale	...	135
Gray, sandy and micaceous shale	135	145
Sandy and micaceous shale	...	155
Sandy and biotitic shale with some pyritiferous limestone	155	165
Sandy shale, mixed with limestone	165	175
Fine sand and shale showing thin carbonaceous laminae	175	185
Calcareous, fossil-bearing limestone	...	185
Gray silty shale, not calcareous	185	195
Gray fossiliferous limestone, with some shale	195	205
Shale, greenish gray, unctuous	205	215
Olive gray, unctuous clay	215	225
Gray shale, in part sandy, in part, calcareous	225	235
Greenish gray limestone and some black shale	...	245
Gray shale, marly and unctuous	245	255
Micaceous, gray, soft shale	...	265
White limestone	270	273
Coal and black shale containing organic fragments. On the label is the note: "Coal at 292 ft."	285	295
Limestone, somewhat shaly and containing grains of pyrite. Some fragments are greenish	295	305

Description of samples from test hole at Thayer—Concluded.

	Depth in feet. From.	To.
Dark, pyrite-bearing limestone, obscurely fossiliferous	...	315
Coal, evidently representing only a part of the depth from	315	326
Gray, fossiliferous and sandy limestone	335	...
Gray marl	335	345
Light gray shale with some calcareous spherules noted measuring .125 mm. in diameter	345	355
Gray sandy and micaceous shale	355	365
Dark gray and soft marl	375	...
Gray silty shale very slightly calcareous	375	385
Black shale like "miner's slate"	385	395
Shale and limestone	395	405
Limestone, some dark and some light gray, with some fragments of sandstone	...	405
Unctous, light-gray shale	415	425
Black shale and some limestone	435	445
Fireclay, unctuous, with slickensided joints, and minute fragments of calcareous material and coal	455	465
Sandy shale	465	475
Clean sand, moderately coarse showing secondary crystalline facets, some "mineral charcoal" and a few calcareous fragments	550	560
Clean coarse sand, with secondary crystalline facets. On the label is the note: "Shale between these two sands, with water, twenty gallons per minute	600	625

20. CITY WELL, SHELBYVILLE, SHELBY COUNTY.

Samples from a well bored at Shelbyville, Shelby County, were submitted by Dr. W. J. Eddy, of Shelbyville, for examination. The driller's determination were noted on the labels giving the depths at which the samples were taken. These determinations are quoted after the writer's description.

Description of samples from well at Shelbyville, Illinois.

	Depth in feet.
Dark shale, sandy and micaceous, and some sandstone of fine texture. There are also some fragments of impure brown limestone and of light gray limestone. *Endothyra* was noted. "Blue shale"	240
Gray micaceous shale and sandstone of fine texture. The fragments frequently show thin laminae, broken pieces of carbonaceous material. "Gray sandstone"	285
White limestone, compact in texture, and containing organic fragments. The rock has specks of black bituminous material, and also small spots of bright green granules. Two crinoid joints, *Rhombopora lepidodendroides*, and other bryozoa noted. "Limestone"	300
Gray shale, some dark, and some light, coarse and micaceous. A few ferruginous concretions, which probably made the drillings look brown when wet. "Brown shale"	390
White limestone in thin fragments. Fragments of shells and spines of brachiopods noted. "White limestone"	420
Gray limestone, with less than one-fourth the quantity of embedded fine sand. One fragment with proportionately more embedded sand, has the appearance of sandstone. The grains are small and angular and are held in a matrix which makes more than half of the mass. "Gray sandstone"	460
Black shale, irregularly bedded, containing a great number of small crystals of selenite. "Black shale"	470
Micaceous sandstone of fine texture, or sandy shale, filled with shreds of carbonaceous material. "Blue shale"	485

Evidently all of these samples come from the Pennsylvanian. The limestone at 300 feet below the surface most closely resembles the limestone above coal No. 6, but lies, perhaps above the depth at which this limestone would be looked for.

21. WELL ON FRED JENSEN'S FARM, NEAR TUSCOLA, DOUGLAS COUNTY.

This well is located on the NE. ¼ sec. 15, T. 15 N., R. 7 E., in Bourbon Township, near Tuscola, Douglas County. It was drilled in 1908.

A set of small samples of borings was submitted to the writer by Mr. J. L. Dawson of Tuscola. These were taken irregularly at depths from 3 to 100 feet apart.

Description of samples of well near Tuscola, Illinois.

	Depth in feet.
Gray limestone, soft, impure	103
Like the preceding but with joints of crinoid stems and a *Seminula argentea*	109
Limestone with many joints of crinoid stems, pieces of shells of brachiopods and *Rhombopora lepidodendroides*	117
Limestone with fossils as in the preceding	120
Gray marly shale, with spines of production in profusion	130
A red breccia of calcareous organic fragments	175
Micaceous sandstone	218
Micaceous sandstone	230
White sandstone	270
Organic limestone of coarse texture, with some black grains	370
The same	370
White organic limestone, with some gray shale. A *Nodosaria?* was seen embedded in the limestone	390
Rock like the preceding	395
Gray limestone, some compact in texture	405
Fine grained sandstone, micaceous, with some fragments of coal	450
Sandstone, fine grained and micaceous	455
Sandstone, fine grained and micaceous	460
Like the preceding	465
Gray sandstone	485
Gray sandstone, micaceous. Label on sample says "Salt water"	490
Sand and shale with some marly material. Label says: "Salt water"	500
White limestone, with fragments of a brachiopod shells	550
Some pieces of limestone, black shale and coal	560
Coal	580
Limestone, with joints of crinoid stems, pieces of brachiopod shells and *Rhombopora lepidendroides*. Many fragments contain interlacing curving tubes of *Ammodiscus* measuring about .15 mm. in diameter	660
Limestone, with crinoid joints	680
Sandstone	715
Marly gray material of exceedingly fine texture; slime from drill	790
Yellowish sand. Label says: "Salt water"	875
Yellowish sand. Label says: "Salt water"	880
Brown sand, coarse. Label says: "Salt Water"	885
Brown sand. Label says: "Salt water"	890
Gray sand, not coarse. Label says: "Salt water"	893
Yellowish gray sandstone, micareous. Label says: "Salt water"	975
Like the preceding. Label says: "Salt water"	980
Like the preceding. Label says: "Salt water"	985
Gray shale	1,060
Coal	1,090
Sandstone, coal, and limestone	1,100
Fire clay or shale, sand, and some limestone	1,150
All fragments of concretionary pyrite of iron. Label says: "Same 1,270 feet from surface drill stuck, had to abandon well, lost two strings of tools"	1,170
A fragment of pyrite, one-half inch in diameter. Label says: "Sample that came upon top of sand bucket weighed 3 pounds, from cave-in	(?1,270)

A sample of yellow salt accompanied the other material. The label of this sample reads: "Sample Salt: 1 gallon water, boiled down and dried, weighed 9 ounces. From 875 to 985 feet."

In a letter dated Nov. 28, 1908, addressed to the writer, Mr. J. L. Dawson says: "I have no other record of the borings of the well, except samples sent to you. The drillers only saved the sand when there were

any changes. Gas came from the deep salt sand about 800 feet and burned freely. It had no odor."

All the samples are believed to consist of material from the Pennsylvanian, or from the strata later than the Mississippian. The horizon of coal No. 6 is believed to be at depths of 560 to 580 feet.

22. ILLINOIS POWDER COMPANY'S WELL, GRAFTON, JERSEY COUNTY.

Eleven samples from the Illinois Powder Company's well, drilled at Grafton, Jersey County, were submitted for examination by R. S. Blatchley of the State Geological Survey in September, 1910. The original labels, evidently written by the collector in Grafton and quoted verbatim below, show that each sample represents distinct portions of the section varying from 9 to 177 feet in thickness, and evidently regarded as uniform in character. Hence the exact depth from which each sample as taken can be made out only within the variable limits of each indicated portion of the section. The writer is inclined to believe that the sample number two (see below) represents only the upper part of the rock penetrated at depths from 75 to 252 feet, and that the lower and the greater part of this division consists of the shales and limesone of the Cincinnatian formation. Drilling through these shales goes on rapidly and the ground shale is apt to run off from the bucket with the water. It is a matter of general occurrence that inexperienced collectors of well samples neglect taking samples of, and even fail to note the occurrence of, shale strata. The writer's interpretation of this section is therefore as follows:

Record at Grafton (Interpretation).

	Thickness in feet.	Depth in feet.	
		From.	To.
Drift?	24	0	24
Niagaran limestone	51	24	75
Niagaran and Cincinnatian limestone and shale	189	75	264
Galena and Trenton limestone	391	264	655
St. Peter sandstone	117	655	772

Description of samples from original labels of well at Grafton, Illinois.

"1. Depth of strata: 51 feet from 24 to 75 feet."
Yellow calcareous limestone of fine texture, with some fragments of yellow dolomitic limestone, with some white chert and some chalcedonic quartz.

"2. Depth of strata: 177 feet, from 75 to 252 feet."
Light bluish or greenish gray dolomitic limestone, with some of the fragments tinged green, and a few containing embedded grains of a greenish black mineral resembling glauconite. Some of these grains are rounded, lie close together, and measure from .25 mm. to .5 mm. in diameter.

"3. Depth of strata: 12 feet, from 252 to 264 feet."
Dark gray dolomitic limestone, showing some slender embedded black spines or threads, with some greenish shale.
"4. Depth of strata: 102 feet, from 264 to 366 feet."
Calcareous limestone, some dark brown, some yellow and some white. The white limestone shows black specks, as much as .25 mm. in diameter, being embedded crystals and minute spheroidal concretions of marcasite. The same mineral also occurs in irregular clusters of minute crystals. Most of the fragments of the yellow limestone and of the light brown limestone consist of a light gray matrix in which lie embedded grains of a brown mineral .06 mm. in diameter or less. Small fragments of the rock float on water, as if impregnated with bituminous material.
"5. Thickness of strata: 9 feet, from 366 to 375 feet."
Calcareous limestone, yellowish white, consisting of worn organic fragments, frequently measuring from .25 mm. to .05 mm. in diameter. One large fragment showed *stylolites* impregnated with a black bituminous film, and such films were noted in other fragments in which were no stylotic structures. The rock yields a bituminous odor when crushed and small fragments float on water. Crystals of marcasite .06 mm. in diameter were noted. A few thin dark fissile shale fragments.
"6. Thickness of strata: 39 feet, from 375 to 414 feet."
Calcareous limestone, mostly gray, some white and some very dark fragments. Some gray fragments are sandstone, consisting of small sand grains lying in a calcareous matrix. Some fragments of fossils, some clear calcite and some fine marcasite were also noted.
"7. Thickness of strata: 146 feet, from 414 to 560 feet."
Dolomitic limestone, straw-colored with some white chert.
"8. Thickness of strata: 25 feet, from 560 to 585 feet."
Calcareous limestone, gray, some fragments with scattered small embedded sand grains. Two large fragments showed a green tinge along healed fractures. Fragments of fossils were noted. There was some black shale, which effervesced slowly with acid.
"9. Thickness of strata: 20 feet, from 585 to 605 feet."
Dolomitic limestone, straw-colored and finely granular.
"10. Thickness of strata: 50 feet, from 605 to 655 feet.
Dolomitic limestone, gray, containing some very fine quartz sand with grains measuring .125 mm. in diameter.
"11. Thickness of strata: 117.5 feet, from 655 to 772.5 feet. Water-bearing sand."
Pure and clean siliceous sand, with the grains mostly from .16 mm. to .33 mm. in diameter. Most grains well rounded, some with facets due to secondary growth.

23. WELL NO. 1 IN LAVINA THIERER'S FARM, MERIDIAN TOWNSHIP, CLINTON COUNTY.

This well was drilled for the Ohio Oil Company in the E. ½ NE. ¼ sec. 36, Medidian Township, Clinton County, about 250 feet from the Marion County line. The elevation of its curb is estimated to be 500 feet above sea level. Samples were submitted to the writer who examined them with the result indicated in the following table: (Coal No. 6 is near 510 feet below the surface and the base of the Pennsylvanian is somewhere near 970 feet below the surface. Below 970 all is the Chester.)

Description of samples from well No. 1 on Thierer farm, Clinton County, Illinois.

	Depth in feet. From.	To.
No samples	0	265
Shaly sandstone and shale	265	270
Gray sandy shale and some siderite	270	275
Gray sandy shale, with lime matrix	275	280
Gray sandstone and black shale. Some yellow limestone	280	285
Gray sandstone with infiltrated calcareous material	285	290
Dark gray sandy shale, with a few fragments of limestone	290	295
Gray micaceous shale	295	300
Gray shaly sandstone	300	305
Gray shale	305	310
Dark shale of fine texture	310	315
Gray shale	315	335
Black shale	335	345

Description of samples from well No. 1—Continued.

	Depth in feet. From.	To.
Black shale and coal. "Clod" limestone with fossil fragments. Minute gasteropod noted	345	350
Gray sandstone with siderite spherules embedded, and coal	350	355
Light gray sandy shale	355	360
Micaceous sandstone, shaly	360	365
Sandy shale	365	370
Sandstone	370	375
Sandy shale	375	380
Dark sandy shale	380	385
Black shale	385	390
Gray shale and sandstone	390	400
Gray sandy shale	400	405
Gray shale	405	410
Dark, almost black, shale	410	425
Like the preceding, brownish black limestone	425	440
Almost black, very fine clay, containing brownish black limestone. Very difficult to wash	440	445
Gray shale, micaceous with some concretionary clay ironstone and some organic limestone	445	450
Sandy shale, micaceous, with some organic limestone and spherules of siderite	450	455
Brown marly clay and greenish gray, calcareous limestone of waxy lustre and containing occasional organic fragments	455	460
Brown marly clay with limestone, as above	460	465
Gray marly shale, with a few fragments of red shale and limestone	465	470
Gray marly shale and limestone	470	475
Gray marly clay, and limestone, sandstone and black limestone with pyrite	475	480
Black shale	480	485
Black fissile shale, gray shale, and coal	485	490
Gray fire clay, shale and coal with some limestone	490	495
Gray shale, limestone, and coal. *Fusilina* quite frequent, four specimens noted. Also *Chonetes, Productus,* crinoid stems and bryozoa	495	500
Gray marly shale	500	510
Black coaly shale and coal, with some sand	510	515
No sample	515	520
Dark shale and coal	520	525
Dark clay shale with coal and limestone	525	535
Gray shale	535	565
Coal and sand	565	570
Gray shale	570	580
Gray shale, dark, with some organic limestone	580	585
Coal and black shale, with some limestone	585	590
Black shale	590	595
Black shale and coal	595	600
Black shale	600	610
Black shale and sandstone	610	615
Dark fire clay with some effervescing material	615	620
Black shale, sandstone and a little coal	620	625
Gray shale and sandstone	625	630
Mostly gray sandstone	630	640
Gray sandstone and shale, with some pyrite	640	645
Sandstone and shale	645	650
Sandstone, white limestone, and coal	650	655
Gray sandstone	655	660
Gray sand	660	685
Gray sand with some dark limestone	685	695
Gray sand	695	710
Gray sand with some dark limestone	710	715
Yellow sand	715	740
Yellowish white sand	740	745
Gray sand	745	755
Gray sand with some shale	755	760
Sandstone and shale	760	765
Gray shale	765	770
Sandy shale	770	780
Sandy dark shale	780	785
No sample	785	790
Gray sandstone	790	795
Gray sand, carbonaceous and laminated	795	800
Sandstone, gray, micaceous and calcareous, filled with oil and bitumen	800	805
Gray sandstone, calcareous	805	810
Gray sandstone, with calcareous material, and pyrite	810	815
Gray shale and sandstone	815	820
Gray shale and sandstone, with pyrite	820	825
Gray shale	825	830
Gray shale and sandstone	830	835
Coarse, porous sandstone, with shale and concretionary siderite, black or brown; pyrite and a few coarse quartz grains	835	840
Like the preceding, with a crinoid stem joint	840	845
Coarse and porous sandstone with black carbonate of iron concretions	845	850

Description of samples from well No. 1—Continued.

	Depth in feet. From.	To.
Yellow sand	850	875
Stony gray shale, siderite fragments and gray sand	875	880
White sand	880	885
Yellowish gray sand	885	890
Clear white sand	890	895
Yellow sand with some dark shale	895	900
Black sandy shale and limestone, with coal, pyritized wood and shale	900	905
Gray sandy shale, siderite concretions and pyrite	905	910
Some sandy shale, some dark shale with concretionary material	910	915
Dark and sandy shale, some siderite and pyrite, and some coal	915	920
Sandy shale, coal, some limestone, and fire clay	920	925
Gray shale and coarse grained sandstone	925	930
Black shale and white sandstone	930	935
Black stony shale, and sandstone	935	945
Dark gray shale and sandstone, with pyrite	945	955
Shale and siderite, gray	955	960
Gray shale and siderite	960	965
Gray shale and siderite	965	975
NOTE.—From 945-975 the greater part of the washings were split into flat plates. Color gray; texture that of limestone; no effervescence.		
Black and green shale	970	975
Black and green shale and limestone. *Rhombopora lepidodendroides* present	975	980
Black and dark shale and limestone	980	990
Dark green shale with some fragments of laminae of homogeneous quartz, and some organic calcareous fragments, one crinoid joint	990	995
Like the preceding, with some pyrite	995	1,000
Like the preceding, with more calcareous fragments	1,000	1,005
Dark gray calcareous shale, with shell fragments and a few red stony shale fragments	1,005	1,010
Dark greenish gray, stony shale with some red shale	1,010	1,015
No sample	1,015	1,020
Like that from 1,010 to 1,015 feet	1,020	1,030
Dark greenish gray shale, with crinoid joints, fragments of shells and occasional sand grains	1,030	1,035
Dark greenish gray shale, with fragments of a clean, white fine grained sandstone, cemented with calcite, effervescing	1,035	1,040
Dark shale and sandstone with infiltrated calcite. The sandstone is of uniform, fine texture and quite hard. It is free from mica	1,040	1,065
Like the preceding with a few fragments of white limestone	1,065	1,070
Black shale, sandstone, and some limestone	1,070	1,075
Black shale and white sandstone, with some thin layers of sandstone of the same color as the shale	1,075	1,080
Dark greenish gray shale, with some white sandstone, and some red shale	1,080	1,085
Black shale and white sandstone	1,085	1,090
Like the preceding but more sandy	1,090	1,095
Black shale and white sand in about equal amounts	1,095	1,100
Dark green shale	1,100	1,105
Dark, almost black, greenish shale, giving no effervescence, with some red shale, and a few dolomitic fragments. (2 samples)	1,105	1,115
Greenish gray sandstone and some dark shale	1,115	1,130
Greenish black shale, with some sand, and occasional fragments of red shale	1,130	1,135
No sample	1,135	1,140
Mostly sandstone with some green shale	1,140	1,150
Light gray, dark gray, and greenish gray shale, with frequent organic calcareous fragments	1,150	1,155
Mostly white organic limestone, with some shale	1,155	1,160
Mostly gray organic limestone, bryozoa and crinoid stems, with some gray shale	1,160	1,165
Dark shale and organic limestone. Minute echinoid spine noted, also bryozoa	1,165	1,170
Dark gray shale and organic limestone	1,170	1,185
Brown clay and dark shale. Effervesces with acid	1,185	1,195
Dull brownish clay and dark shale	1,195	1,200
Dark, almost black, stony shale	1,200	1,205
Dark green shale, with some red shale and with some red blotched limestone	1,205	1,215
Dark, almost black shale	1,215	1,220
Gray shale, red shale, and gray crinoidal limestone, organic, oolitic, small echinoid spine noted	1,220	1,225
Dark shale and crinoidal limestone	1,225	1,240
Like the preceding, with *Archimedes* (?) fragment	1,240	1,245
Dark shale and crinoidal limestone, with an *Athyris*	1,245	1,250
Dark shale and organic calcareous material	1,250	1,255
Red shale and greenish dark gray shale, with organic fragments, *Cyclopora* (?)	1,255	1,260
Varicolored shale and some limestone	1,260	1,265
Red shale	1,265	1,275

Description of samples from well No. 1—Continued.

	Depth in feet. From.	To.
Reddish gray shale	1,275	1,280
Red shale, marly	1,280	1,285
Organic oolitic limestone, white, with some shale	1,285	1,295
Variegated shale; oolitic limestone; gray, shaly, organic limestone	1,295	1,300
Gray shale; oolitic limestone, and organic limestone	1,300	1,305
Dark gray shale, mostly	1,305	1,310
Dark gray shale, some red shale, with limestone	1,310	1,315
Dark gray shale,and oolitic limestone	1,315	1,320
Dark gray shale showing carbonaceous shreds of vegetation, and pyrite	1,320	1,330
Dark gray shale, with shreds of carbonaceous material, gray sandy shale, gray organic limestone and some pyrite	1,330	1,340
Gray shale and white fine-grained sandstone	1,340	1,345
Gray and dark gray shale, with some limestone and sandstone	1,345	1,350
Gray sand and some shale, a little limestone	1,350	1,355
Gray sand, some calcareous shale and red shale	1,355	1,360
No sample	1,360	1,365
Gray sand with a little limestone	1,365	1,370
Gray sand and a little limestone	1,370	1,375
Gray sand, gray shale and limestone	1,375	1,380
Gray sand and a little dark shale	1,380	1,385
Gray sand and some dark shale	1,385	1,390
Sand	1,390	1,395
Sand of fine texture, the greater part of the grains are from .125 mm. to .25 mm. in diameter	1,395	1,400
Yellowish gray sand of same texture as last sample	1,400	1,405
Yellow sand	1,405	1,410
White sandstone with grains mostly from .125 mm. to .25 mm. in diameter. Some chips of dark shale	1,410	1,415
White sandstone with some fragments of calcareous rock, some calcite and shale. Bryozoa noted	1,415	1,420
Dark gray shale	1,420	1,435
Dark gray shale with some crinoidal limestone	1,435	1,445
Limestone, shale and fine sandstone	1,445	1,450
Brown shale, limestone and fine sand	1,450	1,455
Brown shale and limestone	1,455	1,460
Brown shale and limestone; dark shale	1,460	1,465
Some limestone, crinoidal, and some dark shale. Some limestone fragments have a bright orange red, or "lobster" color	1,465	1,470
White sand, limestone, and gray shale	1,470	1,475
White sand and varicolored shale. Sand from .06 mm. to .125 mm. in diameter. Maximum .25 mm.	1,475	1,485
Varicolor shale with a little sand	1,485	1,490
Purplish brown, greenish and gray shale, with some gray to purplish organic and structureless limestone	1,490	1,495
Dark purplish brown shale	1,495	1,500
Dark and purplish brown shale with a little sandstone of fine texture	1,500	1,505
Light greenish gray sandstone of fine texture, some purplish brown shale, and some limestone	1,505	1,510
White sand, grains from .125 mm. to 25. mm. in diameter, and some limestone	1,510	1,515
White sand and a little dark gray shale	1,515	1,520
White sand and a little gray shale	1,520	1,525
White sand with some purplish grains	1,525	1,535
Dark greenish gray shale with some organic limestone	1,535	1,540
Like the preceding, with some white, fine sand	1,540	1,545
Fine white sand, with some dark, greenish gray shale	1,545	1,560
White sand	1,560	1,565

The mechanical analysis of the sand in this sample is as below:

Diameter in mm.	Per cent.
2— 1	0.0
1— .5	2.6
.5— .25	6.0
.25—.125	84.5
.125—less	6.9

Fine sand (lost in one sample)	1,565	1,580
Fine white sand	1,580	1,585
Fine white sand	1,585	1,590

The mechanical analysis of the sand in this sample is as below:

Diameter in mm.	Per cent.
2— 1	0.0
1— .5	3.4
.5— .25	6.5
.25—.125	70.7
.125—less	19.0

Fine white sand	1,590	1,595
Yellowish white sand	1,600	1,605
Black shale, sponge spicules (?)	1,605	1,610
Yellow sand and limestone, some dark shale and iron filings	1,610	1,615
Yellow sand, some limestone, dark shale and iron filings	1,615	1,620

Description of samples from well No. 1—Concluded.

	Depth in feet. From.	To.
Limestone and some yellow sand	1,620	1,625
Limestone	1,625	1,630
Black shale, emitting sulphurous odor when ignited	1,630	1,640
Black shale filled with petroleum, effervesces with acid	1,640	1,645
Like the preceding; crinoid joints present	1,645	1,650
Dark gray shale and fine-grained sandstone, cremented with calcite	1,650	1,655
Dark greenish gray shale	1,655	1,660
Greenish dark gray and black shale. Pyrite noted	1,660	1,675
Fine white sand with some shale like that in the preceding samples	1,675	1,685

24. WELL NO. 1, ON GUTHRIE'S FARM, SANDOVAL TOWNSHIP, MARION COUNTY.

Well No. 1 on the Guthrie farm in the SW. ¼ SW. ¼ sec. 28, in Sandoval Township, Marion County, was drilled for Mr. M. L. Zahniser. All the samples of the drillings seen by the writer belong either in the Pennsylvanian or the Mississippian. The former extend to a depth of 1,360 feet. Everything below this depth is Mississippian. The elevation of the well's curb is estimated to be 495 feet above sea level.

Description of samples from well No. 1 on Guthrie farm, Marion County, Illinois.

	Depth in feet. From.	To.
Blue boulder clay	26	30
Boulder clay, washed	30	40
Drift	40	50
Micaceous sandy shale	50	55
Sandstone	55	60
Shale	60	70
Unctuous shale, light bluish	70	85
Gray micaceous shale	85	90
Gray micaceous sandy shale	90	95
Unctuous blue shale	95	100
Dark gray micaceous shale	100	105
Bluish gray unctuous shale	105	130
Sandy fossiliferous sandstone and shale, and gray sandstone with infiltrated lime	130	135
Dark gray unctuous shale	135	140
Dark gray stiff shale	140	150
Sample missing	150	170
Impure coal and fire clay	170	175
Greenish gray fire clay	175	180
Brecciated gray limestone and black shale	180	185
Gray sandy limestone, with fragments of shells	185	190
Gray micaceous sandstone and sandy shale	190	195
Sandy shale	195	200
Dark gray shale	200	205
Micaceous sandy shale	205	230
Shaly sandstone, showing shreds of carbonaceous material	230	240
Dark gray shale	240	250
Black coaly shale. (Another sample with same number, but probably coming from below this, consists of gray shale and sandy calcareous rock)	250	255
Gray sandy micaceous shale and shaly sandstone, filled with interstitial lime	255	260
Gray clay shale, some limestone and black shale	260	265
Micaceous sandy shale	265	270
Gray and white laminated sand	270	275
Dark stiff shale	275	290
Dark micaceous shale	290	300
Dark stiff shale	300	315
Dark stony shale ,like the preceding	315	340
Gray stiff shale	340	345
Gray shale	345	350
Gray and white limestone, with coal and fire clay	350	355
Fire clay, coal, limestone	355	360
Fire clay, shale and siderite concretions	360	365
Sandstone and fire clay	365	370
Gray sandy shale	370	375

Description of samples from well No. 1—Continued.

	Depth in feet. From.	To.
Sand and sandy shale	375	380
Sand containing carbonaceous material. Oily	380	385
Gray shale, micaceous sand	385	405
Gray shale	405	410
Gray sandy shale	410	415
Gray shale	415	445
Dark gray shale	445	460
Black shale "clod," with small gasteropod, small *Athyris* umbo, and a crinoid stem, and coal	460	465
Nodular calcareous sandstone and impure sandstone	465	470
Dark shale and siderite	470	480
No sample	480	485
Black shale	485	490
No sample	490	495
Black shale, calcareous rock, and some white limestone	495	500
Gray sandy shaly material, some white limestone and some black shaly calcareous rock. *Fusilina, Chonetes punctatus,* and crinoid stems noted	500	505
Gray sandstone and dark shale. A few bits of limestone	505	510
Dark shale and some coal. A few pieces of white limestone	510	515
Gray sandstone	515	520
Gray sandy shale, some black shale, and bits of yellowish white limestone. Pyrite noted	520	525
Black shale	525	530
No sample	530	535
Black shale	535	540
Dark gray and black shale	540	545
No sample	545	550
Gray shale	550	555
Gray micaceous shale	555	560
Gray micaceous sandstone and a few pieces of coal	560	565
Gray micaceous shale and bits of siderite. (Second sample with this label)	560	565
Black shale and coal, with a few pieces of white and dark limestone and pyrite	565	575
Black shale and a few pieces of coal	575	580
Gray sandstone, some yellow limestone, and a little shale and pyrite	580	585
Gray micaceous sandstone and a little shale	585	590
Black shale	590	605
(Second sample, with somewhat same label). Dark shale, a few pieces of yellow limestone and coal	600	605
Gray micaceous shale and some coal	605	610
Dark shale	610	615
Gray micaceous shale	615	620
Gray shale and yellow, slowly effervescing limestone. Bits of olive green sandstone	620	625
Dark gray shale	625	630
Gray shale	630	640
Gray shale and some black shale	640	650
Gray shale	650	655
Gray micaceous shale	655	660
Gray micaceous sandy shale, some gray micaceous shale, and a few pieces of pyrite	660	665
Gray micaceous shale	665	670
No sample	670	675
Gray shale	675	680
Gray shale, a little gray sandstone, and concretionary siderite	680	685
Gray micaceous shale and a few pieces of concretionary siderite	685	690
Gray micaceous shale	690	695
Dark shale	695	700
Gray shale	700	705
Gray shale, some imprints of leaves	705	710
Gray micaceous shale and a little sandstone	710	715
Gray shale	715	720
Gray shale and some siderite concretions	720	725
Dark gray shale and some siderite	725	730
Gray shale	730	740
Dark gray shale	740	745
Dark gray shale and some siderite	745	750
Gray sandy shale and a few small pieces of white limestone	750	755
Gray sandy shale	755	760
Dark shale	760	765
Gray micaceous shale	765	770
Gray sandy shale	770	775
Gray micaceous sandy shale	775	780
Gray micaceous shale, some siderite and black sandy shale	780	785
Gray micaceous shale	785	790
Gray sandstone, some coal, some white limestone, pyrite and siderite	790	795
Coal, some gray sandstone, some limestone and siderite	795	800
Gray shale and fire clay, and small pieces of coal and siderite	800	805
Black shale and some coal	805	810

Description of samples from well No. 1—Continued.

	Depth in feet. From.	To.
Black micaceous shale	810	815
Gray shale and coal, with some siderite and pyrite	815	820
Gray shale and some coal, concretionary yellow limestone, and white limestone. Pyrite also noted	820	825
Fire clay, concretions of siderite, white limestone, black limestone and black shale	825	830
Green clay shale and pure gray limestone. The shale is filled with spherules of siderite up to .5 mm. in diameter	830	840
Green shale filled with spherulitic siderite concretions, some sandy pyritiferous shale and some fragments of limestone	840	845
Some green shale, and much concretionary limestone. Some of the limestone is white and pure, some is in the form of black concretions with center of calcite, some is a gray rock filled with spherules of siderite, and other small grains of siderite, while some is brownish red and brecciated and contains organic fragments	845	850
White sandstone, some shale, and a few fragments of limestone	850	855
Gray shale and shaly sandstone	855	860
Like the preceding	860	865
Sandy shale, some black shale, and some coal	865	870
Very micaceous white sandstone	870	875
Micaceous sandy shale	875	880
Gray micaceous sandstone	880	885
Shaly gray sand	885	890
Like the preceding	890	895
Gray micaceous sand with much pyrite, some of which is interstitial in the sand	895	900
Sand. (Sample very small)	900	905
Sandy, light gray and shaly rock	905	910
Like the preceding	910	915
Samples wanting	915	930
Dark stony micaceous shale	930	935
Like the preceding	935	940
Gray sandstone	940	945
Sand and black laminated stiff shale. Sample marked: "Salt water in this sand, or Bridgeport sand"	950	960
Coarse rounded sand, with brownish black grains which effervesce very slowly in acid. Many crinoid stems were noted, which did not effervesce in acid and which had the appearance of consisting of siliceous material	960	975
Coarse gray sand mixed with siderite fragments and pyrite, and some fire clay	975	980
Gray sandstone, siderite and fire clay	980	985
Gray fairly clean sand, showing secondary crystalline enlargement	985	990
Gray sand, showing secondary enlargement of grains	990	1,000
Yellowish gray micaceaus sandstone. Note on label of this sample: "From M. L. Zahniser, Centralia, Ill."	1,000	1,005
Gray sand and some limy material	1,005	1,010
White micaceous sand with some limy material	1,010	1,015
White micaceous sand	1,015	1,020
Coarse white sand	1,020	1,025
Coarse white sand showing secondary enlargement of some grains	1,025	1,030
Gray sand showing secondary enlargement of some grains	1,030	1,035
Coarse gray sand (2 samples)	1,035	1,040
Gray sand	1,040	1,045
Fine gray micaceous sand	1,045	1,055
Gray sandstone, some pieces showing lamination. Some dark shale	1,055	1,060
Gray sandstone, some dark greenish, micaceous shale. Pyrite present	1,060	1,065
Coarse gray sand, some gray shale, a little coal, pyrite and limestone of obscurely spherulitic concretionary structure	1,065	1,070
Dark shale and some white sandstone, a little coal and bits of siderite. (2 samples)	1,070	1,075
White sandstone and concretionary siderite, some pyrite and dark shale. A few red conchoidally breaking fragments were noted which were hard and did not effervesce. This sample was labeled "dark sand" by the driller	1,075	1,080
Gray fire clay of fine texture	1,080	1,100
Dark gray shale, fine in texture and comparatively soft	1,100	1,110
Dark gray and black shale	1,110	1,115
Greenish dark micaceous shale	1,115	1,130
Greenish black shale of fine texture	1,130	1,135
Dark micaceous stiff shale	1,135	1,145
Dark shale with siderite concretions	1,145	1,150
Dark shale	1,150	1,155
Dark greenish shale, with a few minute and iridescent mica scales	1,155	1,175
Dark shale, gray fire clay and coarse sand	1,175	1,180
Gray sand showing secondary crystalline faces on some grains	1,180	1,195
Dark greenish gray micaceous shale, speckled with minute black fragments, probably carbonaceous	1,195	1,200
Gray shale and concretionary siderite	1,200	1,205
Gray sandstone, coarse, with a white siliceous interstitial cement, and some gray shale and siderite	1,205	1,210

Description of samples from well No. 1—Continued.

	Depth in feet. From.	To.
Gray shale and concretionary siderite, with some small pieces of sandstone	1,210	1,215
Black micaceous shale, some siderite	1,215	1,220
Gray sandy shale, some sandy shale and a little black shale	1,220	1,225
Gray micaceous shale	1,225	1,230
Gray micaceous shale	1,230	1,235
Greenish gray sandy and micaceous shale	1,235	1,240
Mostly a brown, apparently fragmental, siderite with the texture of an organic breccia, with white coarse sandstone and gray shale	1,240	1,245
Fragmental and granular brownish siderite, white sandstone and gray shale	1,245	1,250
White sandstone and granular siderite	1,250	1,255
Laminated, white, pure sand, with granular brown siderite	1,255	1,265
Yellowish gray sandstone of fine texture	1,265	1,270
Yellowish gray sand of fine texture, clean	1,270	1,275
Greenish black shale of very fine texture	1,275	1,290
Greenish dark shale and fine sand	1,290	1,300
White sandstone, with infiltrated matrix of calcareous material in part, and some shale. Driller's note: "Sandy lime"	1,300	1,310
Dark shale and white sandstone with infiltered lime. Driller's note: "Sandy lime"	1,310	1,320
Dark shale and a little sandstone with infiltered lime. Bits of pyrite	1,320	1,330
White, somewhat coarse sand and a little dark shale. Pennsylvanian in aspect. A carbonaceous film or shred was seen adhering to a small piece of sandstone	1,330	1,345
Yellow sand with a few flakes of mica and some dark shale. Driller's note: "Salt sand." Pennsylvanian in aspect	1,345	1,360
No sample	1,360	1,365
Yellow sand and some gray oolitic limestone	1,365	1,370
No sample	1,370	1,385
Gray oolitic limestone. Driller's note: "Lime"	1,385	1,395
Gray oolitic limestone	1,395	1,400
Gray shale with a few bits of pyrite	1,400	1,410
Dark shale and white sandstone with infiltered lime. Driller's note: "Sandy lime"	1,410	1,440
Black shale and some white sandstone with a little infiltered lime	1,440	1,445
Black shale and some white sandstone with infiltered lime	1,445	1,450
Dark shale, some white limestone and red shale. Driller's note: "Sandy lime and top of red rock for 30 feet past"	1,450	1,455
Gray shale and organic white fragmental limestone. In this limestone are pieces of *Fenestella*, *Polypora* (?) echinoid spines, fluted and tuberculated, some spicules (?) and fragments of brachiopod shells, and crinoid stems. Some red shale noted	1,445	1,460
Like the preceding, with echinoid spines	1,460	1,465
Organic fragmental limestone and dark gray shale	1,465	1,475
Black shale and organic fragmental limestone	1,475	1,485
Organic fragmental limestone and some green shale	1,485	1,490
Organic fragmental limestone and black shale. Some gray sandstone and an *Athyris* noted	1,490	1,495
Dark shale. Some limestone and crinoid stems noted	1,495	1,500
Dark and red shale, with some calcareous material	1,500	1,505
Dark green shale	1,505	1,510
Bluish black shale	1,510	1,515
Gray shale and reddish yellow shale with considerable calcareous material	1,515	1,525
Greenish black and brownish black shale of fine texture	1,525	1,530
Brownish red shale, with a yellowish streak	1,530	1,535
Brownish red shale, and dark greenish gray shale	1,535	1,540
Brownish and greenish gray shale. Driller's note: "Red rock in all 1,530 to 1,547 feet"	1,540	1,550
Greenish gray shale	1,550	1,560
On the cover of this sample is written: "Top of lime 1,560 feet. Cased here." The sample consists of a grayish white shell breccia, which consists of small and thin shell fragments lying more or less flat in the same plane, showing small *Athyris* valves—and shells of other brachiopods, and crinoid stems	1,560	....
Greenish sandy shale or shaly sand, with some red shale, and some white sandstone of fine texture. Brachiopod spines noted	1,560	1,570
Dark greenish sand of very fine texture with some white fine sand. Pyrite noted. On cover of sample is the note: "Top of Benoist, or oil sand"	1,570	1,575
Dark green sand of very fine texture, with some shale of the same color. Pyrite, white sandstone, with limestone and spines and shells of brachiopod noted. Labeled: "Benoist sand"	1,575	1,580
White sand with grains of about .125 mm. in diameter. Driller's note: "Oil sand"	1,580	1,585
Greenish gray sand and sandy shale, some of which shows incipient fissures along which oxidation has taken place and the material has assumed a red color. Some of the shale is red. Crinoid stems and fragments of brachiopod shells noted. Sample marked: "Benoist or oil sand"	1,585	1,600

Description of samples from well No. 1—Concluded.

	Depth in feet. From.	To.
Siliceous white gray and green sandstone of very fine texture. Size of grains in this as in previous two samples about .06 mm. in diameter. Some dark gray, greenish gray and red shale. Some sandy shale was noted with joints of oxidized red material intersecting the green. This rock shows thin laminations	1,600	1,605
Greenish gray, gray, and dark brown sandstone of very fine texture. This rock is laminated, showing bright green layers alternating with gray, brown and red layers. The laminae are from .06 mm. to .5 mm. in thickness and more, and are quite straight. On the cover of the sample is the note: "Bottom of oil or Benoist sand"	1,605	1,610
Light gray sand, slightly micaceous and apparently slightly coarser than the preceding; some dark sandy shale and some dark brown shale	1,610	1,615
Gray sand coarser than the above and ground up into separate grains. These average about .16 mm. in diameter. On cover of sample is the note: "Salt water sand"	1,615	1,625

25. WELL NO. 1, ON OPPENLANDER'S FARM, ASHLEY TOWNSHIP, WASHINGTON COUNTY.

This well was drilled for the Ohio Oil Company in the Oppenlander farm in sec. 16, T. 2 S., R. 1 W., in Ashley Township, Washington County. Its curb is at an estimated elevation of 540 feet above sea level. The material penetrated to a depth of 1,045 feet is evidently Pleistocene and Pennsylvanian. All below this depth is Chester.

Description of samples from well No. 1, Oppenlander's farm, Washington County, Illinois.

	Depth in feet. From.	To.
Loess	1	25
Boulder clay	25	46
Gray micaceous shale	46	55
Black shale, "clod," coal and fire clay	55	60
Limestone, fragmental ,with bryozoa, crinoid stems, black shale, coal and gray shale	60	75
Micaceous gray sandstone, with some siderite and black shale	75	90
Organic fragmental limestone, with crinoid stems, *Rhombopora lepidendroides* and *Fusulina*. All specimens of *Fusulina* were undersized	95	107
Gray sandy shale, with some fragments of coal	107	122
Gray shale and crinoidal limestone, with a *Rhombopora*, and a small lamellibranch in pyrite	122	140
Gray shale and much clay ironstone	140	148
Gray micaceous shale and some white limestone	148	156
Dark gray micaceous shale	156	164
Dark gray shale	164	175
Gray limestone containing crinoid stems and spines, *Rhombopora lepidodendroides, Phonetes*, sp.	175	181
Black shale and coal	181	196
Light gray sandstone of fine texture, with some concretionary calcite	196	207
Sand and sandy light gray shale, much clay ironstone, and a few large pieces of coal	207	212
Gray micaceous shale	212	220
Gray micaceous fine sand and gray sandy shale, with clay ironstone	220	225
Very dark gray micaceous and sandy shale, with clay ironstone	225	237
Black shale of fine texture	237	245
Dark gray shale of fine texture	245	252
Dark shale of fine texture	252	260
Gray sandstone of fine texture, with some little bone coal	260	265
Gray micaceous sandstone of fine texture, with clay ironstone	265	272
Gray micaceous sandstone of fine texture	272	280
Gray micaceous sandstone and sandy shale	280	285
Gray micaceous sandstone	285	310
Gray sandstone, with embedded shreds of vegetation	310	330
Gray sandstone	330	...
Dark gray shale, "clod," with crinoid stems, pyrite and some little coal	345	358
Black shale, "clod" and coal, some red shale	358	365
Gray shale, dark gray shale and gray fine sand	365	372
Dark gray micaceous shale, with octahedral pyrite	372	380

Description of samples from well No. 1—Continued.

	Depth in feet. From.	To.
Dark gray micaceous shale	380	387
Like the preceding	387	395
Light gray micaceous sandstone	395	402
Dark gray shale	402	408
Dark gray shale	408	415
Gray shale	415	422
Dark shale, micaceous	422	430
Dark micaceous shale	430	437
Dark stiff shale	437	450
Black shale and gray shale	450	458
Black stiff shale and gray shale	458	470
Gray sandy shale, some fire clay, and some coaly shale	470	483
Dark shale, red ochreous shale, and red shaly sandstone	483	495
White limestone; crinoid stems noted	495	502
Green shale, gray shale and fire clay containing small spherules of manganese (?)	502	507
Green shale, red shale, fire clay, limestone fragments and fragments of black coaly shale	507	515
Micaceous shale and micaceous gray sandstone	515	523
Micaceous and sandy greenish gray shale	523	530
Micaceous gray shale	530	537
Gray, fairly coarse micaceous sand	537	545
Like the preceding	545	555
Like the preceding	555	562
Like the preceding	562	571
Like the preceding	571	579
Like the preceding	579	585
Like the preceding	585	592
Like the preceding	592	600
Yellowish brown sand	600	607
Like the preceding	607	611
Gray sandstone	611	617
Gray sandstone of fine texture	617	624
Gray sandstone of fine texture	624	631
Gray shaly sand	631	639
Gray fine sand	639	645
Like the preceding	645	652
Gray sand	652	660
Gray sandstone	660	667
Gray sandstone	667	674
Gray sand	674	680
Gray sand	680	686
Almost white sand	686	692
Like the preceding	692	698
Like the preceding	698	708
Like the preceding	708	714
Like the preceding	714	721
Gray sand	721	728
Gray sand	728	737
Gray sand	737	743
Sand. With this is some black bituminous (?) material and some coal, some of which has evidently been partly burned. Probably all the coal is an accidental admixture	743	747
Gray shaly sandstone	747	755
Gray sandy shale	755	761
Gray sandstone of fine texture	761	768
Gray shale of fine texture	768	775
Gray shale	775	782
Gray shale	782	790
Gray shale	790	795
Gray shale, and some red shale	795	801
Dark gray shale of fine texture	801	807
Like the preceding, with some red shale	807	813
Shale, fire clay and coal	813	820
Dark gray shale of fine texture	820	826
Dark shale of fine texture and fire clay	826	833
Black clay shale, impure coal and "clod"	833	839
Dark shale, fire clay and concretionary material	839	845
Like the preceding	845	851
Dark gray and light gray laminated micaceous shale	851	858
Dark gray, almost black micaceous shale	858	864
Black stiff shale	864	870
Like the preceding	870	876
Black and gray stiff micaceous shale	876	882
Dark stiff micaceous shale	882	888
Like the preceding	888	894
Dark stiff shale	894	900
Like the preceding	900	907
Gray micaceous sandstone	917	914
Gray micaceous sandstone	914	920
Gray micaceous sandstone	920	926

Description of samples from well No. 1—Continued.

	Depth in feet. From.	To.
Gray micaceous sand and dark gray shale	926	933
Medium coarse gray sand with secondary facets	933	939
Like the preceding	939	945
Like the preceding	945	951
Like the preceding	951	957
Yellowish gray medium coarse sand, .25 mm. to 1 mm. in diameter, with secondary facets	957	964
Like the preceding	964	970
Like the preceding	970	975
Yellowish gray sand with a few fragments of coal	975	981
Yellowish gray sand	981	989
Brownish gray sand	989	995
Brownish gray sand, with some grains exceeding one mm. in diameter	995	1,000
Brownish gray sand like the preceding	1,000	1,005
Like the preceding	1,005	1,010
Almost white sand, fine grained	1,010	1,015
Like the preceding	1,015	1,021
Like the preceding	1,021	1,026
Gray sand, with some brown fragments of sandstone	1,026	1,033
Gray, pink and brown sandstone of fine texture	1,033	1,038
Like the preceding, but finer	1,038	1,044
Red shale and some blue shale, of fine texture, like the Chester shales.	1,044	1,049
Like the preceding	1,044	1,049
Black shale, red shale and gray shale of fine texture	1,054	1,060
Black shale	1,060	1,065
Fine gray sand, with some red shale, some black shale and some pink sandstone	1,065	1,070
Like the preceding	1,070	1,075
Like the preceding	1,075	1,081
Fine, light gray sand, grains mostly less than .25 mm. in diameter, with some pink sandstone	1,081	1,087
Like the preceding	1,087	1,093
Like the preceding	1,093	1,100
Like the preceding, but darker	1,100	1,106
Fine, gray sand, with some coarse sand grains, some little black shale and some dark gray fragmental limestone	1,106	1,112
Gray marly shale	1,112	1,117
Gray marly shale	1,117	1,122
Gray marly shale	1,122	1,126
Gray marly shale. Note on sample sack: "Some cave in these samples up here"	1,126	1,131
Like the preceding	1,131	1,135
Like the preceding	1,135	1,140
Shaly lime rock, mostly black, also dark brown, bluish black, and gray	1,140	1,146
Dark bluish black calcareous shale and a little limestone	1,146	1,152
Bluish black and reddish dark brown shale	1,152	1,158
Bluish black and dark brown shale, with pink satin spar (calcite) fragments, that evidently are from layers about one-eighth of an inch in thickness. The fibrous structure is vertical to the fragments of the layer	1,158	1,164
Dark gray, almost black, shale, with some dark red fragments. Satin spar (calcite), as in the preceding	1,164	1,170
Like the preceding	1,170	1,176
Like the preceding	1,176	1,182
Like the preceding	1,182	1,188
Bluish black shale with some fragments of gray fine grained sandstone	1,188	1,194
Like the preceding	1,194	1,199
Like the preceding	1,199	1,204
Like the preceding	1,204	1,209
Mostly black shale with a few fragments of white sandstone	1,209	1,214
Like the preceding	1,214	1,219
Fine gray sand	1,219	1,225
Like the preceding	1,225	1,230
Like the preceding	1,230	1,235
Fine gray sand with some black shale	1,235	1,241
Like the preceding	1,241	1,247
Like the preceding	1,247	1,253
Fine gray sand with some dark gray, some dark green, and some dark red, shale	1,253	1,258
Like the preceding	1,258	1,264
Like the preceding	1,264	1,269
Moderately coarse gray sandstone, with almost black shale, splitting into thin narrow splinters	1,269	1,275
Like the preceding	1,275	1,280
Gray, organic fragmental limestone, crinoid joints noted	1,280	1,285
Like the preceding	1,285	1,290
Like the preceding	1,290	1,295
Like the preceding	1,295	1,300
Like the preceding	1,300	1,305

Description of samples from well No. 1—Concluded.

	Depth in feet. From.	To.
Like the preceding	1,305	1,310
Like the preceding	1,310	1,315
Greenish gray shale with scattered minute black shreds of vegetation	1,315	1,320
Greenish gray shale	1,320	1,325
Greenish gray and red shale	1,325	1,330
Greenish gray and red shale	1,330	1,336
Like the preceding	1,336	1,340
Like the preceding	1,340	1,345
Greenish, gray, dark bluish gray and dark purple brown shale	1,345	1,350
Dark gray shale and red shale, with gray oolitic limestone	1,350	1,355
Dark greenish gray shale, red shale and organic fragmental gray limestone	1,355	1,361
Like the preceding	1,361	1,366
Gray organic fragmental limestone, dark gray shale and red shale	1,366	1,371
Like the preceding	1,371	1,376
Like the preceding	1,376	1,381
Like the preceding	1,381	1,386
Gray shale	1,386	1,391
Gray crinoidal limestone and dark gray shale	1,391	1,396
Like the preceding	1,396	1,401
Crinoidal and oolitic gray limestone and dark gray shale	1,401	1,406
Gray limestone and shale. *Terebratula* noted	1,406	1,411
Gray and red marly shales	1,411	1,414
Like the preceding	1,414	1,419
Like the preceding	1,419	1,424
Like the preceding	1,424	1,429
Missing	1,429	1,434
Gray and red marly shales	1,434	1,440
Like the preceding	1,440	1,445
Dark gray limestone, dark gray shale and red shale	1,445	1,450
Like the preceding	1,450	1,455
Gray crinoidal limestone and some dark gray shale	1,455	1,460
Gray limestone of fine texture with some crinoid joints embedded	1,460	1,465
Like the preceding	1,465	1,470
Gray limestone of compact texture with some fine sand	1,470	1,475
Dark, almost black shale, and some red and gray shale	1,475	1,480
Black and grayish black shale	1,480	1,485
Greenish black or gray shale, marly	1,485	1,490
Like the preceding	1,490	1,495
Red shale and dark greenish gray shale	1,495	1,500
Like the preceding	1,500	1,505
Dark gray shale	1,505	1,510
Dark gray shale	1,510	1,515
Brown shale and gray and yellow stony shale	1,515	1,520
Like the preceding	1,520	1,525
Greenish gray sandy shale, or sandstone, dark gray shale and some red shale	1,525	1,530
Gray sandstone of fine texture, black shale and brown shale	1,530	1,535
Gray sandstone of fine texture, with some dark shale	1,535	1,540
Like the preceding	1,540	1,545
Yellowish gray fine grained sandstone	1,545	1,550
Like the preceding	1,550	1,555
Like the preceding	1,555	1,560
Brown sand, coarser than the preceding	1,560	1,565
Like the preceding	1,565	1,570
Greenish gray and red marly shale	1,570	1,575
Dark almost black shale and greenish gray calcareous shale	1,575	1,580
Like the preceding	1,585	1,587
Like the preceding	1,587	1,592
Like the preceding	1,592	1,596
Like the preceding	1,596	1,600
Black shale and crinoidal, organic fragmental limestone showing specks of intense green	1,600	1,605
Like the preceding	1,605	1,610
Like the preceding	1,610	1,615
Like the preceding	1,615	1,620
Missing	1,620	1,625
White organic fragmental (crinoidal) limestone and black greenish gray, and red shale	1,625	1,630
Red, gray and green shale, and white crinoidal limestone	1,630	1,635
White crinoidal limestone, showing occasional green fragments	1,635	1,640
Brownish red quartz sand of fine texture	1,640	1,645
Gray sandstone, limestone and dark shale	1,645	1,650
Brownish sand of fine texture	1,650	1,655
Brownish gray sand of fine texture	1,655	1,660
Light gray fine sand	1,660	1,665
Pinkish brown fine sand	1,665	1,670
Like the preceding	1,670	1,675
Gray fine sand	1,675	1,679
Like the preceding	1,679	1,687

26. WELL OF ILLINOIS CENTRAL COAL AND SALT COMPANY, ST. JOHNS, PERRY COUNTY.

This well is one of the deepest drillings made in the State. Prof. Frank Leverett has published the driller's record of this well on pages 772-773, Monograph 38 of the United States Geological Survey. Some additional descriptions of the rocks penetrated by the drill can now be given, especially from the deeper part of the section which seems to be least detailed in Leverett's report. Nineteen samples were lately given to the writer by Dr. Stuart Weller. These consisted of the following:

Description of samples from well at St. Johns, Illinois.

	Depth in feet.
Bluish gray limestone with bryozoa, *Pentremites*, crinoid stems, *Athyris*....	1,107
Dark red shale	1,111
Two samples of gray sandstone, one with a slight amount of calcareous cement. Between 1,190 and.....	1,280
Three fragments of blue shale showing several bryozoa, among which were some *Archimedes*	1,290
An organic calcareous breccia, in which green clay was present between some of the fragments	1,305
Mostly fairly clear fragments of calcite crystals.....	2,271
Green unctuous shale (about)	3,000
Very dark greenish shale, black when wet, laminated.....	3,001
Black shale, bituminous, broken into small and slender quadrangular prismoids. 3,087 to.....	3,099
Greenish black shale, splitting into thin long and slender fragments. In some fragments are thin round minute flakes of brown or yellow calcareous material, lying flat with the bedding planes	3,100
Black shale with much translucent brown bituminous material in flakes of irregular forms. When heated it emits distinctly bituminous odor, with white fumes. It is apparently identical with the shale in sample taken at 3,087-3,099. The sample contains some rounded oval quartz (?) grains, about .16 mm. in diameter. From 3,099 to.....	3,102
Dolomitic, fine-grained, straw-colored limestone, cherty.....	3,127
Dolomitic limestone, with much chert, straw to white in color.....	3,300
Dolomitic limestone, straw-colored and much gray chert of fine texture....	3,380
Slightly dolomitic yellow limestone, fine textured, with much dense chert...	3,525
Gray calcareous limestone with some some crystalline calcite and some fine-textured bluish green, shale-like limestone, effervescing slowly with acid	3,350

During the progress of the drilling in 1897, Mr. John Forester, who superintended the work, was in correspondence with Dr. C. H. Crantz, Curator of the Illinois State Museum of Natural History, in Springfield. Several small samples of cuttings were submitted to Dr. Crantz for examination. This correspondence, and some of the samples were loaned to the writer for further examination in 1909, and the following observations were made:

Description of samples from well at St. Johns, Illinois.

	Depth in feet.
Light gray, almost white, limestone, which effervesces briskly in acid. Also many fragments of crystalline calcite. The depth at which this sample was taken is not noted in the letter with which it was enclosed, but judging from the date of the letter, Sept. 27, 1898, it was from somewhere near	(?) 2,200
Yellowish light gray limestone, effervescing briskly in acid. Spoken of in letter dated Oct. 7, 1897, as coming from the "top of the rock we are now in." Somewhere about	(?) 2,300
Dark gray limestone, effervescing moderately slowly in acid, and containing scattered minute black specks, visible under the microscope. The rock is of microscopic crystalline structure. The accompanying letter dated November 15, contains the note: "We have been in the Trenton for the last 400-500 feet." Depth is given as.....	2,500

Description of samples from Well at St. Johns—Concluded.

	Depth in feet.
Dark gray dolomitic limestone, with minute black specks, which in two fragments appeared as parallel black needles. Under a ¼-inch objective these specks appeared as large as the dot in the letter i. One green grain was noted. Forwarded in letter dated Nov. 29, 1897. Depth.....	2,540
A limestone like the preceding sample in every particular. Sample in a letter dated Dec. 22, 1897. Depth.....	2,550

From letters written by J. Forester to several parties the following items have been obtained:

"Light-gray limerock extended from 3,001 to 3,063 feet. This rock was harder at depths of from 3,026 to 3,057, than elsewhere. There was a light green shale at from 3,063 to 3,085 feet. A dark gray limerock was penetrated at from 3,085 to 3,087 feet. This is said to have been hard to cut. Black sand is mentioned as having been found at depths of from 3,099 to 3,102 feet. In a letter written Jan. 27, 1899, when drilling was going on at 3,400 feet below the surface, Mr. Forester says that 'there was more than 200 feet of limestone above this level. Above this limestone there was shale.'"

An interpretation of the record of this well must be doubtful. There can be no question that the first 490 feet are in the Pennsylvanian sediments, nor is there any doubt that the strata from 1,000 to 1,600 feet belong to the Chester. The well is near a region where the Devonian series is known to be more than a thousand feet thick. Taking all these things into consideration, the present writer would make the following interpretation:

Interpretation of record of well at St. Johns, Illinois.

	Thickness in feet. From.	To.
Pennsylvanian or Pottsville	0	490
Chester, including unknown overlying beds	490	1,595
St. Louis	1,595	1,940
Warsaw	1,940	2,095
Burlington and Kinderhook	2,095	2,300
Devonian and Niagaran, the latter probably in small thickness	2,300	3,053
Cincinnatian	3,053	3,153
Galena and Trenton	3,153	3,600

With this interpretation the limestones are Ordovician. The crevice yielding salt water at 2,275 feet below the surface is in the lower part of the Burlington limestone, where a water-bearing cavernous rock is common in the central part of the State. The sand reported in the drillings from this depth may possibly be finely comminuted chert. The relationship of the limestones, shales, and sandstones from 500 to 1,000 feet below the surface is problematic. They are probably Mississippian. As this locality is near the central region of a structural basin, differential sinking might account for the prolonged continuation of sedimentation in the Mississippian sea in this region.

27. WELL NO. 1, ON THE L. GALLAGHER FARM, PERRY COUNTY.

This well drilled for the Mid Valley Oil Company is in the SE. ¼ NW. ½ sec. 17, T. 6 S., R. 3 W., Perry County. The elevation at its curb is estimated to be 450 feet above sea level. A study of the samples obtained during the drilling shows that the Chester series begins at a depth of 740 feet.

Description of samples from well on the Gallagher farm.

	Depth in feet. From.	To.
Yellow loess	1	6
Surface clay (yellow) and some sand grains	6	15
No sample	15	24
Drift, sand and pebbles and a little dark shale	24	32
Yellow loess and other drift	32	40
Sand, coal fragments and drift pebbles	40	48
Gray micaceous sandstone and drift pebbles	48	58
Gray shale, siderite, black shale, gray limestone, drift pebbles and chert	58	67
Sand, siderite, and drift pebbles	67	74
Gray shale, weathered and containing some calcareous material	74	84
Black limestone	84	87
Black slaty shale, highly bituminous and some coal	87	92
Black shale, with some limestone, some sandstone and some fire clay	92	98
Gray sandstone, yellow concretionary limestone, black shale and mineral charcoal	98	105
Dark gray micaceous shale	105	114
Gray sandy micaceous shale, showing dark and light laminae and gray sandstone with embedded yellow spherules of siderite	114	120
Gray, white and yellow sandstone, dark gray sandy shale, and some white and yellow sandstone. Some of the sandstone contains shreds of carbonaceous material and some contain spherules of siderite	120	127
Black shale, very bituminous, waxy to the knife, and a dark gray, coarse, organic, brecciated limestone	127	135
Black shale, "clod," containing a small tuberculated gasteropod and fragments of other fossils, coal and fire clay	135	143
Coal and fire clay	143	149
Coal and fire clay	149	153
Gray micaceous sandstone and some fire clay	153	160
White micaceous sandstone	160	166
Gray sandstone with embedded spherules of siderite	166	172
Gray clay shale, gray sandstone, siderite, pyrite and some limestone	172	178
Gray sandy shale, black shale, limestone, concretionary siderite and pyrite	178	184
Gray shale and fire clay, coal, black shale, and pyrite	184	190
Black shale, gray fire clay, coal, pyrite and some limestone	190	196
Black shale, coal, organic calcareous fragments, woody tissue, pyrite and fire clay	196	202
Sandy shale, gray, and some greenish gray shale	202	206
Gray shale, some coal and limestone	206	212
Gray shale, black shale, coal, siderite and limestone	212	218
Gray sandstone, gray shale, black shale, coal and pyrite	218	224
Dark and black shale, gray sandstone, concretionary siderite, carbonaceous woody tissue and pyrite	224	230
Black shale, gray sandstone, siderite, fragments of red, brown and yellow limestone	230	236
Yellowish gray limestone, gray shale, gray sandy shale, bright red rock fragments, and sandstone	236	242
Dark gray sandstone, soft, and of fine texture	242	248
Gray sandy shale, siderite, pyrite, and some white calcareous fragments	248	254
Gray shale, with some siderite and pyrite	254	260
Gray shale, gray sandstone with carbonaceous fragments, some fragments of red rock, some limestone and pyrite	260	272
Coal, siderite, fire clay and pyrite	272	278
Black shale containing laminae of coal, white and gray limestone, with crinoid stems, and a small tuberculated gasteropod. Pyritized woody tissue, some bright red rock, and some siderite	278	284
Pyrite, black shale, pyritized woody tissue, siderite, some calcite and some limestone	284	290
Gray limestone, concretionary siderite, and pyrite	290	295
Gray micaceous shale, some gray sandstone with carbonaceous shreds and some siderite	295	301
Dark micaceous shale with some fragments of calcareous material	301	306
Gray sandstone and gray shale	306	312

Description of samples from well on the Gallagher farm—Continued.

	Depth in feet. From.	To.
White micaceous laminated sandstone with some shale	312	318
White sand	318	334
Gray sandstone, red sandstone, siderite, black shale, pyrite, spherules of siderite, and limestone	334	340
White sandstone and some shale	340	346
Coarse white sand	346	352
Micaceous white sandstone, coarse, with a few fragments of limestone, pyrite and siderite	352	358
White sand	358	370
White sandstone, fairly coarse	370	376
White micaceous sand	376	384
Light gray sandstone	384	390
White micaceous sand	390	396
Gray sand and shale	396	401
White sandstone, some shale and calcareous material	401	404
Light, dark gray, and a little brown shale and fine sandstone	404	407
Fine, white, micaceous sandstone	407	410
Coarse white sand	410	415
Sandstone, laminated, white, micaceous. A pebble of quartz about one-eighth inch noted	415	420
Fine white micaceous sandstone	420	425
Gray micaceous sand	425	430
Gray sand	430	435
Coarse sand of many well rounded grains	435	440
White and gray sandstone of coarse rounded grains with infiltrated carbonate of lime and some small pieces of shale	440	445
Coarse gray micaceous sand and a little dark shale	445	450
White sand	455	461
Coarse white sandstone and a little pyrite	461	466
White micaceous sandstone	466	472
White sandstone	472	484
White micaceous sand	484	490
White sand	490	508
Pure white sand	508	514
White sand	514	520
Coarse white sand	520	525
Gray calcareous sandstone of fine texture	525	528
Mostly dark gray and black shale, some sandstone and quartz grains	530	535
Sandstone, limestone, pyrite and shale	535	540
Dark shale, white sandstone, and a little limestone	540	546
Gray and red sandstone, gray shale, and pyrite	546	552
White micaceous sandstone and some gray shale	552	558
White sandstone, fairly coarse	558	564
Gray micaceous sand, and a little dark shale	564	569
White sandstone and a little red shale. Sand grains with secondary crystal faces	569	574
Pink, purple, brown, yellow and white sandstone	574	580
White, gray, dark, pink, and brown sandstone	580	585
White quartz sand	585	590
White sand with secondary crystallization	590	596
White sandstone and a little gray shale	596	602
White sand with some grains showing secondary growth	602	608
Clean white sand	608	614
Pure white sand showing secondary crystallization	614	620
White sandstone and a few grains of coal	620	625
White and fine grained sandstone, pyrite, a little coal and shale	625	630
Limestone, black and white shale, fine sand and quartz crystals	630	635
Gray micaceous sand and a little gray shale	635	640
Fine-grained quartz sand, some black shale and fragments of limestone	640	645
Gray sand	645	650
Gray, micaceous and fairly coarse sand and a little shale and some limestone	650	655
White sandstone with dark laminae, fragments of coal, some shale, fragments of siderite concretions, some pyrite and some red grains	655	660
White sandstone	660	665
Gray micaceous sand, some limestone, and some gray shale	665	670
Gray sandstone, pink sandstone and dark gray shale	670	675
Gray calcareous sandstone showing minute shreds of vegetation and pyrite	675	680
Dark limestone and shale, some calcite, pyrite, a little white limestone. Brachiopod spine noted	680	685
Gray shale with some fragments of limestone and pyrite	685	690
Bluish black shale and organic fragmental limestone	690	695
Gray calcareous sandstone, dark gray shale, some fragments of black bituminous material, some gray limestone and pyrite	695	700
Gray, red and white sandstone, gray and black shale, and some limestone. Aspect: Pottsville	700	705
Gray sandstone, dark shale, some red, green and brown fragments of limestone and a little pyrite	705	710
Gray sandstone and dark shale	710	715

Description of samples from well on the Gallagher farm—Continued.

	Depth in feet. From.	To.
Gray micaceous sandstone and some black shale	715	720
Gray sandstone, black shale, some coal, some petrified wood and some pyrite	720	723
Gray laminated sandstone of fine texture	723	727
Laminated dark gray sandstone and fragments of pyrite	727	732
Gray sandstone, showing carbonaceous shreds and layers	732	738
Greenish black shale and a few fragments of red shale	738	744
Brown and bluish dark shale, some pyrite and some fragments of white sandstone	744	751
Black shale, brown shale, and greenish gray shale	751	757
Organic fragmental limestone and dark gray shale	757	763
Black shale and red shale, and much organic limestone, and some oolitic limestone. A bryozoan noted	763	770
Bluish gray shale	770	776
Dark gray shale of fine texture	776	782
Mostly gray organic fragmental limestone. Some light gray shale. A separate sample labeled 784-785 is also oolitic	782	786
Gray organic fragmental limestone and some dark shale	786	792
Red shale, some greenish, fine-grained sandstone, some black shale, and some limestone	792	798
Gray shaly limestone	798	804
White limestone, dark shale, and some fragments of sandstone	804	809
Dark bluish shale and gray organic fragmental limestone	809	812
Gray organic fragmental limestone and some gray shale	812	815
Black shale, dark gray shale and organic fragmental limestone	815	821
Gray shale and organic fragmental gray limestone	821	827
Organic fragmental limestone and some dark shale. Spines of brachiopods noted	827	832
Gray shale of fine texture, and some gray limestone	832	838
Mostly black shale splitting into thin fragments. A very few quartz grains noted. Also some white limestone and a few fragments of red calcareous rock	838	844
Dark bluish gray shale and organic fragmental limestone	844	850
Gray shale	850	856
Gray shale with embedded shells and some organic fragmental limestone	856	862
Dark gray shale and a little limestone	862	868
Greenish gray shale and organic fragmental limestone	868	874
Dark gray shale with a valve of a brachiopod	874	880
Shale, sandstone and soft clay shale	880	885
Dark gray shale	885	890
Dark gray, fine grained shale and a little limestone	890	895
Black shale	895	900
Black or dark shale, splitting into thin fragments. Pyrite noted. A few fragments of limestone	900	906
Black shale and some gray organic limestone	906	912
Like the preceding	912	918
Dark bluish gray shale, white, fine grained, and some gray limestone	918	924
Like the preceding	924	927
Black shale	927	930
Gray fine grained sand and a few pieces of shale	930	935
White sand of very fine texture	935	940
Quartz sand of fine texture, some black and some gray shale	940	945
Shale and oolitic limestone	945	950
Greenish black shale of fine and uniform texture	950	955
Dark shale of uniform and fine texture, with some limestone	955	957
Dark gray shale of fine and uniform texture	957	960
Bluish dark gray shale	960	965
Gray organic fragmental and oolitic limestone	965	970
Gray organic fragmental limestone and dark gray marly shale	970	975
Oolitic limestone and gray shale	975	980
Limestone and shale, black and gray. Crinoid joints noted	980	985
Gray limestone and dark shale in about equal quantities. One fragment of lobster-red rock	985	990
Gray shale and oolitic limestone in about equal quantities	990	995
Organic fragmental limestone and some shale	995	1,000
Organic fragmental and oolitic limestone and gray, stony and marly shale	1,000	1,003
Gray organic fragmental limestone and gray marly shale. Crinoid joints and fluted echinoid spines noted	1,003	1,006
Dark gray shale and organic fragmental limestone	1,006	1,009
Dark shale, limestone and occasional fragments of chert	1,009	1,012
Organic fragmental limestone, gray shale and some sand	1,012	1,015
Gray and white limestone, dark shale, and fragments of coal	1,015	1,020
Black shale and oolitic limestone. Some joints of crinoid stems and pieces of *Athyris* (?) valves noted	1,020	1,025
Gray limestone and dark gray shale	1,025	1,030
Gray organic fragmental limestone	1,030	1,035
Dark bluish gray shale, and organic fragmental limestone	1,035	1,037
Red shale and green shale, and a few fragments of oolitic limestone	1,037	1,043

Description of samples from well on the Gallagher farm—Concluded.

	Depth in feet. From.	To.
Red shale, greenish shale, and some white limestone	1,043	1,048
Red shale and gray marly shale	1,048	1,054
Red shale and oolitic limestone and some dark shale	1,054	1,060
Black shale with some pieces of red shale and some fragments of coal, pyrite present	1,060	1,070
Black shale and dark fragmental limestone, with a small *Spirifer*. Some red shale	1,070	1,075
Dark gray calcareous shale, with crinoid stem joints and other organic fragments	1,075	1,080
Dark gray and black shale, some gray shale, and white oolitic limestone, which contains bryozoa, crinoid joints, etc	1,080	1,085
White oolitic limestone having coarse organic fragments and black and dark gray shale	1,085	1,090
White oolitic limestone, with large incrusted organic fragments and some black shale	1,090	1,095
Grayish white oolitic limestone, containing joints of crinoids stems and other organic fragments and some black shale	1,095	1,100
A dark gray shale in which are imbedded small calcareous organic fragments. Bryozoa noted	1,100	1,105
Like the preceding	1,105	1,110
Black shale and some shale like that in the preceding	1,110	1,115
Some black shale and some gray shale with embedded minute calcareous fragments	1,115	1,121
Dark gray shale	1,121	1,127
Gray limestone with brachiopods and a *Fistulipora*, and some dark gray shale	1,127	1,134
Dark gray shale and some gray organic limestone. Some of the dark gray shale shows thin interrupted foliations of coal	1,134	1,140
Dark shale and organic fragmental white limestone. A number of the fragments consisted of a shale which was itself made up of minute lumps of greenish and gray shale, small fragments of organic calcareous material and shreds of vegetation changed to coal. Some impressions of leaves also seen	1,145	1,152
Gray shale and organic calcareous fragments with impressions of brachiopods	1,145	1,152
Gray shale and fragments of organic limestone. *Archimedes* and crinoid stems noted	1,152	1,158
Shaly oolitic gray limestone. *Dielasma*, several bryozoa, and joints of crinoid stems noted	1,158	1,163
Gray shale and light gray organic fragmental limestone	1,163	1,168
Dark gray shale	1,168	1,171
Dark gray shale. Some of the shale contains embedded shreds of vegetation	1,171	1,175
Dark gray shale of fine texture	1,175	1,180
Gray shale with bryozoa and a distorted *Athyris*	1,180	1,185
Like the preceding	1,185	1,190
Dark gray shale and gray limestone of very fine texture	1,190	1,195
Dark, greenish gray shale of very fine texture	1,195	1,198

28. WELL OF THE DUQUOIN LAND AND FARMING COMPANY, NEAR DUQUOIN, PERRY COUNTY.

In August, 1910, some samples of drilling from a wild-cat prospect well east of Duquoin, Perry County, were submitted to the writer by Mr. R. S. Blatchley of the Illinois State Geological Survey. This prospect was made on the land of the Duquoin Land and Farming Company in the SW. ¼ sec. 15, T. 6 S., R. 1 W. Most of the samples were taken below the depth of 800 feet, and they are all believed to belong to the Pennsylvanian.

Description of samples from well near Duquoin, Illinois.

	Depth in feet.
Gray sandy shale or sandstone, micaceous, with some sparse calcareous material and some brown embedded grains. There were also some fragments of a brownish and a yellowish-gray rock, which effervesced rather slowly with acid, and which probably was concretionary carbonate of lime and iron	495

Description of samples from well near Duquoin—Concluded.

	Depth in feet.
Olive-colored shale, with some red shale and some concretionary clay ironstone and small grains of marcasite. The shale was of the finest texture. One fragment showed thin laminations of light and dark shale, and another fragment showed a thin layer of marcasite	600
Gray micaceous sandstone with light and dark foliations, with some black sandstone or sandy shale; containing some brown grains of carbonate of iron, and some black shale, all micaceous and slightly calcareous	730
A coarse sandstone, with grains having crystalline facets due to secondary enlargement, held together by a more or less continuous matrix of marcasite. There was also some black micaceous shale	800
Sandy micaceous shale, thinly laminated with light and dark layers from .16 mm. to .5 mm. in thickness. The light layers were most sandy and effervesced slightly with acid and had brown embedded grains of carbonate of iron and lime	805
Black shale in large fragments and white limestone, apparently concretionary, soft but fine in texture and showing a few traces of fossils	810
Limestone like that in the preceding sample, but seen to have a brecciated structure, with occasional irregular small pockets of calcite. Also some white sandstone	815
White limestone, like the preceding, but with minute black specks of marcasite. Also some lumps of shale, one fragment of coal and some coarse sand	820
Some sand, having grains from .25 mm. to .5 mm. in diameter, some rounded and some with secondary crystal facets; some coal, some black shale, and some lumps of green fire clay	825
Sand like the previous sample, but with the grains more frequently facetted, some black shale, some green fire clay, and some coal	830
Gray sand like that in the previous	835
Sand, like the preceding	840
Sand, like the preceding	845
Sand, like the preceding	850
Sand, with most of the grains from .25 to .16 mm. in diameter	855

29. WELL NO. 29, ON FARM OF K. AND E. YOUNG, PARKER TOWNSHIP, CLARK COUNTY.

This well was drilled for the Ohio Oil Company on the farm of Messrs. K. and E. Young, Parker Township, Clark County. Its elevation is unknown. The samples obtained from it begin at a depth of about 1,205 feet.

Description of samples from well on the Young farm.

	Depth in feet. From.	To.
Gray limestone, calcareous, with some white chert, crinoid stems, bryozoan, and brachiopod fragments, and dark greenish gray shale, calcareous. Some yellow pyrite noted. There was also a ¼-in. fragment of black, bituminous shale, with brownish streak, resembling the Sweetland Creek shale. No more fragments of this were noted. It probably came from above the depth where this sample was taken	1,205	1,210
Grayish white calcareous limestone, like that above, with white chert. A bituminous film noted on one fragment	1,210	1,215
Like the preceding, but with less chert	1,215	1,220
Dark gray shaly limestone, and fragments of grayish white limestone. Some of the white limestone shows laminae of dark bituminous material. All calcareous	1,220	1,225
Grayish white limestone, calcareous	1,225	1,240
White limestone	1,240	1,260
Dirty yellow calcareous limestone, too oily to become easily wet; with fragments of crinoid joints	1,260	1,270
Like the preceding, but less oily	1,270	1,277
Somewhat dolomitic limestone, dirty yellowish gray, with some white chert, and considerable calcite. Slightly bituminous	1,277	1,285
Like the preceding	1,285	1,295
Rounded quartz sand, from .5 to .125 mm. in diameter, with some gray limestone, dolomitic (?) in part	1,295	1,315
Brownish dolomitic limestone, slightly bituminous	1,315	1,325
Yellowish gray dolomitic limestone, not unlike the Galena rock in appearance	1,325	1,335
Yellowish gray calcareous limestone	1,335	1,345
Yellowish light gray dolomitic limestone	1,345	1,360
Yellowish light gray dolomitic limestone, with some chert	1,360	1,390

Description of samples from well on the Young farm—Continued.

	Depth in feet. From.	To.
Gray calcareous limestone of fine texture	1,390	1,415
Yellowish gray calcareous limestone of fine texture	1,415	1,430
White, calcareous limestone, with some fragments of chert	1,430	1,740
Gray, calcareous limestone, yellowish	1,740	1,760
Soft, bluish gray calcareous limestone	1,760	1,775
Yellowish gray calcareous limestone	1,775	1,800
White calcareous limestone of fine texture	1,800	1,820
Yellow earthy pulverized limestone, with some white chert	1,820	1,840
Mostly white chert, with yellowish white calcareous limestone	1,840	1,865
White calcareous limestone	1,865	1,880
Light gray calcareous limestone, with translucent chert of same color	1,880	1,890
Light gray calcareous limestone of fine texture	1,890	1,900
Gray calcareous limestone	1,900	1,910
Some white and some dark brown fragments of calcareous limestone of waxy lustre. Also faintly greenish and pinkish fragments. This rock has some resemblance to the Fern Glen of the Kinderhook	1,910	1,935
Brown, yellow, olive green, white calcareous limestone of waxy lustre	1,935	1,960
White calcareous limestone, compact	1,960	1,985
Gray calcareous limestone	1,985	1,995
Pinkish gray calcareous limestone	2,005	2,025
Cream-colored calcareous limestone	2,025	2,040
Gray calcareous limestone	2,040	2,045
Dolomitic limestone, mostly yellowish, some greenish gray; some marcasite, and some white calcite. A part floats. On heating, a faint bituminous odor was noted and strong sulphur fumes	2,045	2,050
Limestone, mostly dolomitic, some black, some gray, some greenish; with marcasite fragments. Dolomitic crystals clearly seen, yellowish	2,050	2,060
A black dolomitic rock, as hard as limestone, no sand noted. The rock is studded with fine grains of marcasite, making a quarter of some fragments	2,060	2,080
Gray dolomitic limestone, somewhat dark	2,080	2,095
Yellowish dolomitic limestone	2,095	2,120
Gray limestone, some dolomitic, some calcareous. With this is some quartz sand and some dark shale, greenish	2,120	2,130
Gray limestone, slightly dolomitic, with some greenish shaly fragments, and some gray chert	2,130	2,150
Like the preceding	2,150	2,160
Gray limestone, effervescing a little tardily for a calcareous rock, with some fragments of grayish white, rapidly effervescing, limestone. Many of the dark limestone fragments appear shaly and contain angular black fragments imbedded	2,160	2,170
Limestone, calcareous, dark gray, faintly shaly, and with rare fragments of brachiopods, also some marcasite. Some slate-like calcite crystals	2,170	2,299
Like the preceding, with some light gray limestone	2,299	2,303
Gray calcareous limestone	2,303	2,307
Calcareous limestone, yellowish light gray, with some calcite	2,307	2,311
Some light gray, some medium gray calcareous limestone, made up largely of organic fragments. A fragment of a brachiopod noted	2,311	2,327
Like the preceding	2,327	2,351
Like the preceding	2,351	2,355
Light gray calcareous limestone	2,355	2,395
Like the preceding	2,395	2,400
Like the preceding	2,400	2,405
Gray, calcareous, organic limestone with some quartz grains	2,405	2,410
Light gray, calcareous, organic limestone with frequent grains of clear calcite	2,410	2,415
Light gray calcareous limestone with frequent calcite crystals	2,415	2,420
Like the preceding	2,420	2,426
Like the preceding	2,426	2,475
Dove-colored calcareous limestone of lithographic texture. Occasionally bituminous films were noted. Fragments, thin	2,475	2,505
Like the preceding in part, in part light gray calcareous limestone	2,505	2,555
Dove-colored calcareous limestone, with some chips of a white calcareous limestone, and with some black fragments of calcareous limestone	2,555	2,585
Calcareous limestone, medium gray. Brachiopods and bryozoa noted	2,585	2,600
Dark dove-colored and gray calcareous limestone of lithographic texture. Brachiopods noted, finely striated valves	2,600	2,670
Calcareous hard limestone, some dark dove-colored, lithographic in texture, with embedded small grains of sand, some light gray, soft calcareous limestone with embedded grains of calcareous material. Clear calcite quite frequent. Some fragments consist of a light gray calcareous matrix, in which some black angular particles are embedded	2,670	2,700
Dark gray, calcareous limestone of fine texture. Brachiopods noted	2,700	2,755
Medium gray limestone, calcareous, compact in texture, with clear calcite in scattering minute crevices, frequently running across the lamination. Splitting in thin fragments, indicating pronounced lamination	2,755	2,770

Description of samples from well on the Young farm—Concluded.

	Depth in feet. From.	To.
Like the previous. Some fragments consist of black limestone layers; pyritiferous, showing some indistinct organic structure (bryozoa? or *Stromatopora?*)	2,770	2,785
Dark gray limestone of fine texture	2,785	2,830
Gray limestone, in part like the preceding sample, in part dolomitic limestone	2,830	2,850
Like the preceding. Some fragments of calcareous limestone were seen to have thin bituminous seams, black	2,850	2,918

A fragment of a shale, believed to be the Sweetland Creek shale, was noted with the limestone from 1,205 to 1,210 feet. It is hence believed that this formation lies somewhere close above this depth. Correlating this shale with the shale at 1,600 to 1,690 in the Lula Shover well record next presented, we note at coinciding levels four other features which are evidently also to be correlated in these two wells, viz:

	Depth in Young well. *Feet.*	Depth in Shover well. *Feet.*
A thin sandstone	1,300	1,825
Pinkish colored limestone	1,940	2,500
Black particles and spicules	2,070	2,650
Black fragments and shreds of vegetation (black)	2,170	2,750

A correspondence in cherty beds is also to be noted. The beds from 1,205 to 1,700 feet in depth are believed to be Devonian. Below this the identification of the formations seems more doubtful.

30. WELL NO. 1, ON FARM OF LULA SHOVER, IN CASEY TOWNSHIP, CLARK COUNTY.

Well No. 1 on the Lula Shover farm was drilled for the Ohio Oil Company in the NW. ¼ SE. ¼ sec. 1, T. 10 N., R. 14 W., in Casey Township, Clark County. Its elevation is estimated to be 600 feet above sea level. The samples of the drillings submitted to the writer are as stated in the following table:

Description of samples from well No. 1 on the Lula Shover farm.

	Depth in feet. From.	To.
Gray shale of fine texture	350	550
Gray sandstone, some moderately coarse in texture and some of fine texture	550	560
Gray and dark gray shale	560	597
Grayish white fine-grained limestone, calcareous, showing no fragments of fossils, Mississippian	597	697
Gray limestone, of very fine fragmental texture	697	750
Gray limestone, with impregnated specks of green in streaks. A few fragments, porous. Chert noted	750	780
Gray oolitic limestone	780	800
Gray limestone, showing some fragments of clear quartz (crystals?)	800	815
Gray limestone, of fine texture	815	820
Gray limestone with scattered embedded dark grains	820	840
Gray limestone, with minute bivalves, crinoid stems, and other fossil fragments	840	850
Gray limestone, with crinoid fragments, bryozoa, and *Endothyra bayleyi*	850	865
Gray limestone, oolitic, with fragments having thin incrustations of calcareous material. The texture of the rock resembles that of the Bedford limestone	865	920

Description of samples from well No. 1—Continued.

	Depth in feet. From.	To.
Brownish gray limestone, showing many dark specks and occasional green specks	970	1,020
White and gray organic limestone, with white chert and dark gray shale	1,020	1,060
Gray organic limestone	1,060	1,090
Dark gray organic limestone	1,090	1,100
Dark gray organic limestone	1,100	1,120
Dark gray organic shaly limestone	1,120	1,155
Gray calcareous stony shale or shaly limestone	1,155	1,195
Like the preceding	1,195	1,270
Gray calcareous stony shale	1,270	1,340
Crinoidal limestone, gray	1,340	1,360
Dark, calcareous stony shale, with scattered minute black specks	1,360	1,400
Dark gray, calcareous, stony shale, micaceous and having some fine sand embedded (2 samples)	1,400	1,440
Dark gray stony shale which does not effervesce with acid and which shows slender branching and curving fucoid-like flat cavities impregnated with marcasite (2 samples)	1,440	1,460
Dark gray fine-grained shale, with some marcasite	1,460	1,480
Greenish gray sandstone, of fine texture, and effervescing slightly in acid	1,480	1,500
Greenish gray fine-grained sandstone	1,500	1,550
Dark gray, stony and calcareous shale, or shaly limestone	1,550	1,565
Green fine-grained shale, showing some dark blotchy, streaky, layers	1,560	1,580
Yellowish gray limestone of compact texture	1,580	1,600
Black, highly bituminous shale of fine texture, with *Sporangites huronense*. Burns with a flame when ignited	1,600	1,690
Gray and white limestone, calcareous, with many organic fragments and with some calcite	1,690	1,714
Grayish white, organic fragmental limestone	1,714	1,730
Grayish white organic limestone, hard, with calcite	1,730	1,760
Grayish white organic limestone, hard, with clear calcite	1,760	1,770
Like the preceding	1,770	1,785
Yellowish gray dolomitic limestone, with some white chert and some fragments of calcareous limestone	1,785	1,800
Yellowish dolomitic limestone, with some impure chert	1,800	1,820
Quartz sand, moderately fine in texture, cream white	1,820	1,830
Yellow dolomitic limestone	1,830	1,850
Brown dolomitic limestone	1,850	1,900
White dolomitic limestone, containing grains of glauconite, and occasional fragments of chert and grains of pyrite	1,900	1,940
Grayish white dolomitic limestone, with considerable white chert, some glauconite and occasional embedded grains of pyrite	1,940	1,950
Like the preceding	1,950	2,000
White dolomitic limestone with some chert	2,000	2,020
Gray dolomitic limestone	2,020	2,050
Like the preceding	2,050	2,150
Gray dolomitic limestone with gray chert	2,150	2,200
White calcareous limestone of fine texture and waxy lustre	2,200	2,220
Gray calcareous limestone	2,220	2,250
Light gray calcareous limestone	2,250	2,275
Gray calcareous limestone, containing a few small grains of sand	2,275	2,285
Dark gray dolomitic limestone, showing thin lamination, somewhat irregular	2,285	2,295
Gray calcareous limestone, of somewhat fine texture	2,295	2,300
Like the preceding	2,300	2,320
White and light gray calcareous limestone	2,320	2,325
Gray calcareous limestone with some light gray limestone having green glauconite grains	2,320	2,330
Light gray calcareous limestone with waxy lustre	2,330	2,335
Light gray calcareous limestone with waxy lustre. Crinoid stem noted	2,335	2,380
Compact white and pure calcareous limestone with much white chert	2,380	2,400
White fine-grained limestone, calcareous	2,400	2,450
Gray and white calcareous limestone of fine texture	2,450	2,355
Pinkish brown calcareous limestone containing occasional crinoid stems	2,455	2,500
Pink, gray and white calcareous limestone with waxy lustre	2,500	2,505
Like the preceding	2,505	2,510
Gray and white calcareous limestone. In one fragment was noted an embedded, minute, almost spherical crinoid joint of pink color. Several other obscure cases of the same kind were noted in this and in the preceding sample	2,510	2,545
Pinkish white calcareous limestone; the pink color is due to imbedded organic fragments, which are yellow and red	2,545	2,565
Like the preceding	2,565	2,570
White calcareous sandstone, containing a few embedded pink grains	2,570	2,600
Gray dolomitic limestone, slightly impregnated with pyrite	2,600	2,610

Description of samples from well No. 1—Concluded.

	Depth in feet. From.	To.
Bluish gray rock, consisting of fine sand in a dolomitic and clayey matrix	2,610	2,615
Dark gray rock, like the preceding in composition	2,615	2,630
Dark gray dolomitic sandy rock. The embedded sand is very fine	2,630	2,640
Gray limestone, with some fragments of white limestone. The gray limestone contains numerous minute, broken black spicules. Several bryozoa noted and also fragments of brachiopods	2,640	2,650
Gray calcareous limestone, containing numerous black minute specks	2,650	2,655
Gray calcareous limestone and chert. The chert is dotted with black minute specks	2,655	2,660
Calcareous organic limestone, some fragments being gray, some dark gray. With this is some white and some gray chert	2,660	2,695
White limestone, with much opaque calcite; crinoid fragments and some quartz crystals and pyrite	2,695	2,700
Gray organic fragmental limestone	2,700	2,705
Light gray, dark gray, and yellowish gray calcareous limestone with some chert. Minute black specks were noted in both the limestone and in the chert	2,705	2,710
Like the preceding	2,710	2,715
Like the preceding	2,715	2,720
Dark gray, fine-grained calcareous limestone, with minute black specks	2,720	2,725
Dark gray calcareous limestone with some chert	2,725	2,730
Like the preceding	2,730	2,735
Very dark gray and black limestone, calcareous	2,735	2,740
Black and gray calcareous limestone. Some of the black limestone was seen to consist of a matrix containing small angular, calcareous fragments, occasionally fractured	2,740	2,750
Mostly a black shaly, limestone, in which appear some black shreds of vegetation. With this is gray limestone. All is calcareous	2,750	2,760
Black shaly limestone, calcareous, with black shreds as above	2,760	2,780
Like the preceding	2,780	2,790
Like the preceding	2,790	2,800
Like the preceding	2,800	2,825
Like the preceding	2,825	2,829½
Like the preceding	2,829½	2,834
Like the preceding	2,834	2,838½
Like the preceding	2,838½	2,843
Like the preceding	2,843	2,853
Black shaly limestone and gray calcareous limestone	2,853	2,857
Gray calcareous limestone, fragmental. Bituminous films noted in minute crevices of some fragments	2,857	2,862
Gray, organic fragmental, calcareous limestone	2,862	2,866½
Gray, organic fragmental, calcareous limestone. Finely ribbed pieces of brachiopods noted	2,866½	2,871
Like the preceding	2,871	2,876
Like the preceding	2,876	2,881
Like the preceding	2,881	2,886
Gray organic fragmental calcareous limestone, with some calcite.	2,886	2,890
Cream-colored, semi-crystalline granular calcareous limestone	2,890	2,903
Gray, granular, partly crystalline calcareous limestone. Organic fragments present	2,891	2,898
Like the preceding	2,903	2,908
Like the preceding	2,908	2,912½
Like the preceding	2,912½	2,917
Like the preceding	2,917	2,922
Like the preceding	2,922	2,925½
Like the preceding	2,926½	2,931
Like the preceding	2,931	2,936
Light gray granular, partly crystalline calcareous limestone, with organic fragments	2,936	2,941
Like the preceding	2,941	2,946
Like the preceding	2,946	2,956
Like the preceding	2,956	2,966
Gray, organic, fragmental calcareous limestone, with granular texture and occasionally clear calcite. Several fragments of a *Favosites?* noted, with polyp tubes very small; also some fragments of brachiopods	2,966	2,971
Gray organic fragmental calcareous limestone, with granular structure	2,971	2,976
Like the preceding, with many bryozoa	2,976	2,983
Yellowish gray organic fragmental calcareous limestone	2,983	2,992
Like the preceding, gray in color	2,992	3,000
Like the preceding	3,000	3,005
Like the preceding	3,005	3,014
Gray, organic, fragmental limestone of the same general type as from the samples below 2,857 feet	3,014	3,017

The limestone in the last 100 feet commonly consists of calcareous fragments some .25 mm. in diameter, which are of different shades, varying from dark gray to white, so as to appear in distinct outline in the generally light matrix.

The formation represented in the samples above a depth of 597 feet is the "Coal Measures." The Bedford oolitic rock lies between 850 and 920 feet below the surface. The Osage, or Burlington, was noted between 1,000 and 1,100. The Sweetland Creek shale lies between 1,550 and 1,690 feet. The cherty limestones lying between 1,785 and 2,200 are no doubt Devonian. Below this the correct correlation of the strata is doubtful. The occurrence of a *Favosites* (?) or a *Monticulipora* from 2,966 to 2,971 feet suggests that this layer may be in the Trenton. The shaly limestone lying between 2,740 and 2,850 feet, and containing some shreds of vegetation may be the equivalent of the Cincinnatian.

31. WELL NO. 4, ON FARM OF C. E. SILER, HONEY CREEK TOWNSHIP, CRAWFORD COUNTY.

Another well operated by the Ohio Oil Company is located on the farm of Mr. C. E. Siler, in sec. 5, of Honey Creek Township, Crawford County. The elevation of its curb is estimated to be 495 feet above sea level.

Description of samples from the Siler well No. 4.

	Depth in feet. From.	To.
Loess or yellow loam	1	5
Gravel and sand	5	10
Sand and gravel	10	15
Sand and gravel, washed from boulder clay	15	20
Boulder clay	20	25
Boulder clay	25	30
Boulder clay	30	35
Boulder clay	35	40
Limestone, with embedded crinoid stem, a small *Spirifer cameratus*, a small gastropod, and a piece of a plant stem. Some roofing shale	40	45
Shale, greenish-gray, micaceous	45	50
Gray shale	50	55
Fine-grained micaceous sandstone with a calcareous matrix	55	62
Arenaceous, gray shale	62	68
Micaceous, gray shale	68	74
Micaceous, dark gray shale	74	80
Micaceous sandstone, with fragments of concretions of siderite	80	86
Sandstone, gray micaceous, calcareous and shaly, with many fragments of yellowish shells	86	92
Gray shale and micaceous shaly sandstone, with a small *Myalina*, and many fragments of shells. Some coal noted	92	98
Some limestone, but mostly shale. The shale is dark gray micaceous and marly. It has many minute, apparently concretionary yellow grains, of siderite. These appear like coarser grains in a fine textured matrix. The limestone is dark with embedded flat fragments of *Myalina* shells, and one piece was seen with embedded deeply marked tubules, believed to be irregularly curving forms of *Ammodiscus*, measuring from .1 mm. to .15 mm. in diameter	98	103
Micaceous sandstone or sandy shale, with some brownish limestone	103	109
Micaceous, gray sandstone of fine texture, almost a shale	109	114
Micaceous sandstone and some green grains, and with calcareous and with some brown calcareous coaly fragments	114	119
Fine grained sand, micaceous, and with brown and green grains, as above	119	124
Like the preceding	124	129
Like the preceding	129	133
Like the preceding	133	139

Description of samples from the Siler well No. 4—Continued.

	Depth in feet. From.	To.
Like the preceding, but with occasional carbonaceous fragments	139	145
Gray, micaceous sandstone, with some dark and some green grains, and some shreds of carbonaceous material	145	150
Black fissile shale ("Miner's slate") with pyritized fossil shells, one probably an *Aviculopecten;* another like a minute *Myalina*	150	155
Some shaly fire clay and a little coal, but chiefly gray micaceous shale, with minute concretions of siderite of the size of small sand grains	155	160
Gray, micaceous, shaly sand. One large fragment showing lines believed to be ripple marks	160	165
Gray, slightly micaceous shale with very thin calcareous laminae	165	170
Gray, slightly micaceous shale with a brownish minute disc-shaped spiral fossil, probably an *Ammodiscus*	170	175
Gray shale, faintly micaceous	175	180
Black fissile shale, with a very fine rectangular reticulation seen on a cleavage plane. Some fragments of coal	180	185
Greenish gray fire clay and shale, with fragments of dark concretionary limestone	185	190
Fine grained micaceous sandstone or shale, with yellow specks of concretionary siderite	190	195
Like the preceding	195	200
Gray, dark, and compact concretionary siderite in large fragments	200	205
Dark gray shale, with *Ammodiscus* (?)	205	210
Mostly dark concretionary siderite in large fragments, with some dark stony shale	210	215
Dark shale of fine texture	215	220
Dark shale, slightly micaceous, with *Ammodiscus* (?) and minute shreds of other fossils	220	225
Dark micaceous shale, slightly calcareous	225	230
Like the preceding, with minute shreds of vegetation	230	235
Like the preceding	235	240
Dark micaceous shale, like that in the preceding sample, with *Ammodiscus* (?) and a small ostracod	240	245
Dark micaceous shale, with impressions of fern leaves, a spiral *Ammodiscus* (?) and one tube of an *Ammodiscus* (?) only slightly curving. Some keeled impressions were noted on one fragment, and joints and spines of crinoids were also seen	245	250
Dark gray shale	250	255
Gray sandy shale	255	260
Gray sandy shale, or shaly sandstone, showing some dark grains under the lens	260	265
Shale, greenish gray, sandy and micaceous	265	270
Greenish gray, micaceous sandstone and red clay marl	270	275
Greenish gray sandy shale	275	280
Comparatively coarse sandstone, with some green and some pink grains. Also some lumps of fire clay, which contain small spherical nodules of black oxide of manganese from .25 mm. to .33 mm. in diameter. Some of these concretions are grown together in groups of two and three	280	285
Comparatively coarse sandstone, with some interlaminated shale	285	290
Mostly sandstone, gray and of fine texture, with some shale	290	296
Micaceous gray shale	302	308
Sandy gray shale or shaly sandstone	296	302
Dark gray shale, not micaceous	308	314
Dark gray shale, not micaceous	314	320
Very dark shale, carbonaceous and sandy. Most of it is finely laminated and shows shreds of vegetation	320	326
Like the preceding	326	332
Like the preceding	332	338
Shaly sandstone or shale, thinly laminated, containing brownish yellow grains (concretionary?) larger than the grains of the rock and also some still larger black grains	338	344
Like the preceding	344	350
Like the preceding, with the brown grains least abundant in the layers of the finest texture, which are carbonaceous	350	356
Sandstone, with interlaminated carbonaceous streaks showing vegetable tissue	356	362
Coal, shale, and sandstone	362	368
Mostly fire clay	368	374
Mostly concretionary material, carbonate of lime and iron and some shale	374	380
Concretionary limestone and siderite, in shale	380	387
Light gray micaceous and sandy shale	387	394
Micaceous and sandy gray shale	394	401
Micaceous sandstone and gray shale	401	407
Dark gray shale	407	413
Dark gray limestone, consisting of organic fragments. Some black shale and coal. The limestone contains *Chonetes mesolobus*(?), crinoid stems and a gastropod (*Bellerophon carbonaria* ?)	413	419

Description of samples from the Silver well No. 4—Continued.

	Depth in feet. From.	To.
Fire clay, gray and black shale and coal	419	426
Gray shale	426	432
Gray fine-grained sandstone	432	438
Gray shale, arenaceous, and micaceous	438	444
Like the preceding	444	450
Shaly sandstone, micaceous, and with rusty specks	450	456
Gray shale, micaceous and sandy	456	462
Dark gray shale, micaceous and sandy	462	468
Like the above, but darker	468	474
Like the preceding	474	480
Almost black dolomitic limestone, uniform in texture, emitting sulphurous odors when heated and becoming slightly magnetic before the blowpipe, containing joints of crinoid stems. *Chonetes mesolobus*(?) *Rhombopora lepidodendroides*(?), fragments of brachiopod shells, and *Fusilina* of the kind occurring in the limestone above coal No. 6	480	486
Black, fissile shale, and some coal, with limestone like that in samples from 480 to 486 feet	486	492
Gray, sandy shale and some dark shale	492	498
Gray, slightly sandy shale	498	504
Soft gray micaceous shale	504	510
Gray shale, soft and micaceous sandstone, with some large and thin fragments of black dolomitic limestone	516	522
Gray sandstone, with some limestone like that in the preceding sample	522	528
Dark gray highly micaceous shale, with scales of biotite and on fresh fractures having an appearance like that of some Archaean schists	528	534
Gray sandstone and sandy micaceous shale, with some dark shale, and fragments of coal	534	540
Dark gray sandy shale, micaceous, with some fire clay	540	546
Dark shale of fine clayey texture	546	552
Dark gray shale, micaceous and stony	552	558
Like the preceding	558	564
Dark gray shale, of clayey texture	564	570
Dark gray shale, with narrow fucoid bands in some cleavage planes	570	576
Black, fissile shale	576	582
Black, fissile shale	582	588
Mostly light gray sandstone, some gray shale, with fragments of coal and limestone	588	594
Mostly light gray sandstone with some dark shale	594	600
Dark, micaceous, shaly, sandstone	600	606
Dark, micaceous, sandy shale	606	612
Dark, almost black shale	612	618
Dark, almost black, shale, with fragments of concretions of siderite	618	624
Gray shale, of clayey texture	624	630
Like the preceding sample	630	636
Gray shale, with some little mica	636	642
Like the preceding sample, but slightly coarser and with a little more mica	642	648
Black shale, of fine texture, but with some mica, and with earthy lustre	648	654
Black shale, much pyrite and some coal. The shale has embedded calcareous fossils among which a piece of a lamellibranch valve and a *Bellerophon* were noted, and also impressions of an insect wing. In the fragments of pyrite was seen a *Nucula*, a *Bellerophon carbonaria* (?) in part filled by zinc blende, and a fragment of a brachiopod. In the coal some woody tissue was noted	654	660
Light gray sandy fire clay filled with small crystals of pyrite	660	666
Dark gray micaceous and sandy shale	666	672
Dark gray shale of fine texture, with pyrite and coal	672	678
Black, fissile shale and finely laminated coal with brown streak. Woody fibre seen in some pyrite	678	674
Shaly fire clay, light gray and stony	684	690
Gray shale and sandstone	690	696
Sandstone, somewhat coarse, laminated, in alternate layers of white and carbonaceous black material; some layers micaceous	696	702
Like the preceding	702	708
Dark gray shale, stony, sandy and micaceous	708	714
Gray shale, stony, sandy and micaceous	714	720
Dark shale, with some laminated coal and some fire clay	720	726
Gray sandstone, shaly and micaceous	726	732
Soft gray shale	732	738
Some gray shale, and some dark micaceous shale with concretionary siderite	738	744
Almost black, fissile shale, with concretionary siderite	744	750
Gray sandstone of fine texture	750	756
Dark gray shale, arenaceous and micaceous	756	762
Laminated, gray sandstone, micaceous, alternate layers black and carbonaceous. The black layers are very thin, the light layers in several cases measuring .1 mm. in thickness	762	768
Coarse micaceous sandstone, laminated with alternate layers of dark carbonaceous shale	768	774

Description of samples from the Siler well No. 4—Concluded.

	Depth in feet. From.	To.
Like the preceding	774	780
Like the preceding	780	786
Like the preceding sandstone, coarser and softer	786	792
Like the preceding	792	798
Dark gray shale and some lighter shale	798	804
Almost black shale, fine in texture	804	810
Like the preceding	810	817
Light gray, sandy shale, slightly micaceous	817	824
Light gray, sandy shale	824	830
Dark gray and light gray shale of fine texture	830	836
Gray sandstone, of very fine texture	836	842
Like the preceding	842	848
Dark bluish gray shale, of very fine texture, with concretionary siderite	848	854
Almost black shale, very fine in texture	854	860
Coarse sandstone	860	866
Almost black shale, fine in texture	866	872
Like the preceding	872	878
Almost black shale, with biotite	878	884
Black shale, fine textured	884	890
Like the preceding	890	896
Like the preceding	896	902
Gray sandstone, fine grained	902	908
Gray sandstone	908	914
Black shale of fine texture, with concretions of carbonate of iron	914	920
Like the preceding	920	926
Like the preceding	926	932
Like the preceding	932	938
Gray shale and sandstone, with some large and thin chips of coal	938	944
Gray soft sandstone and shale. The rock in this and the preceding sample appears to be a mixture of alternating layers of shale and sandstone	944	950
Gray soft sand, only a single fragment of loosely coherent rock remaining in the sample. Size of grains is about .25 mm. in diameter. Apparently oil-sand; the grains float in water	950	955
Gray sand, with grains mostly from .125 mm. to .5 mm. in diameter. The largest grains all have crystalline facets resulting from secondary growth. Sand floats on water	955	959
Sand like the preceding, but faintly brownish yellow	959	963
Sand like that in the three preceding samples, except that it is more nearly white in color	963	967

Two specimens of a *Fusulina* were found in the limestone lying between the depths 480 to 486 feet. This, no doubt, is the limestone which forms the cap rock over coal No. 6. The rock itself has been altered to a dark dolomite, effervescing very slowly in acid. It has a dark gray color, which is due to the presence of pyrite in microscopic particles. On heating in a closed tube it gives off sulphurous odors and becomes slightly magnetic.

The entire section represented by the samples consists of variations of shales, sandstones, limestones, coals, and fire clays, with calcareous concretionary matter, and more frequently concretions of siderite. All the strata have the general appearance characteristic of the Pennsylvanian series in this region. About a dozen coal beds were penetrated. These occur in three groups, not counting an evidently thin bed of somewhat shaly coal, which lies at a depth of 904 feet below the surface and only a few feet above the oil sand. The lowest of these groups, which presumably includes equivalents of coals No. 1 and No. 2 in northern Illinois, is represented by three seams at depths of 720, 678, and 660 feet. The middle group, which includes coal No. 6 is represented by one coal at 540 feet, by coal No. 6 at the depth of 485 feet,

another coal overlain by limestone, at 420 feet, and a coal overlain by sandstone at 365 feet. The coal beds of the Upper "Coal Measures" of Worthen are represented by an apparently small seam of coal at a depth of 185 feet, one small coal associated with a capping calcareous rock at the depth of 95 feet, and a black shale under a limestone at the very surface of the bed rock below the drift, fifty feet from the surface. The spiral shell of an *Ammodiscus* was observed in cleavage surfaces of some shales in the Upper "Coal Measures," and presumably the same fossil, in the form of irregularly curved tubes occurred in some limestone at the depth of 100 feet. The lower 200 feet in the section is probably a part of the Pottsville.

32. WELL NO. 23, ON FARM OF JAS. M. DRAKE, OBLONG TOWNSHIP, CRAWFORD COUNTY.

Another well belonging to the Ohio Oil Company was put down on Mr. James M. Drake's farm in the NE. ¼ sec. 9, T. 7 N., R. 13 W., in Oblong Township, Crawford County, at an estimated elevation of 490 feet above sea level. Its entire section is probably in Pennsylvanian. The last 70 feet may be Pottsville. *Fusulina* was found in the sample from 530 to 535 feet, with coal No. 6, immediately below this.

Description of samples from well on the Drake farm, Oblong Township, Crawford County, Illinois.

	Depth in feet. From.	To.
Gray limestone, some yellow limestone, and bits of shale	200	205
White and yellow limestone, concretionary siderite, and some gray sandstone	205	210
Yellow and white limestone, gray sandstone, concretionary siderite and some dark shale	210	215
Gray sandstone, some yellow sandstone, siderite, yellow limestone, and a few pieces of bright green sandstone	215	220
Yellow limestone, some siderite, shale and sondstone, and red quartz from the drift	220	225
White and yellow limestone and a few pieces of dark shale	225	230
White limestone	230	250
Very fine micaceous white sand and limestone	250	270
Dark gray micaceous sandy shale	270	275
Dark micaceous shale	275	285
Black shale and gray sandstone with a little limestone	285	290
Dark limestone, some yellow limestone and bits of coal	290	295
Black shale, a little yellow limestone and a few fragments of coal	295	300
Gray shale, some yellow limestone and coal	300	305
Gray shale and some yellow limestone	305	310
Gray shale	310	315
Gray shale and some yellow limestone	315	320
Gray shale	320	330
Gray shale and a little yellow limestone	330	335
Gray micaceous shale and some micaceous sandy shale	335	340
Gray shale	340	350
Concretionary siderite with a little yellow limestone and shale. A *Cyathophyllid* coral noted	350	355
Gray shale and a little yellow limestone	355	360
Gray shale, yellow limestone and some sandstone. The shale contains shreds of vegetation	360	365
Gray shale and concretionary siderite	365	370
Gray limestone and some gray shale	370	375
White limestone. A crinoid stem noted	375	380
White limestone, some greenish sandstone and a few bits of coal	380	385
Gray micaceous sandstone and white limestone	385	390
Gray shale and a little limestone	390	395
White limestone and some gray shale	395	400

Description of samples from well on the Drake farm—Continued.

	Depth in feet. From.	To.
Gray shale and some limestone	400	405
Concretionary siderite, some dark shale, bits of coal and pyrite	405	410
Gray sandy shale and siderite. Some yellow limestone	410	415
Dark gray shale, some siderite, and yellow limestone	415	420
Gray sandy shale and some siderite	420	425
Gray sandy shale, black shale and some siderite	425	430
Gray sandstone and a little concretionary siderite	430	435
Gray micaceous sandstone and a few bits of yellow limestone	435	440
Gray micaceous sandstone	440	445
Gray micaceous sandstone with shreds of vegetation. A few small pieces of siderite	445	460
Gray micaceous sandstone and a few small pieces of white limestone	460	465
Gray micaceous sandstone with shreds of vegetation	465	470
Gray micaceous sandstone, some dark shale, a few bits of coal, and pyritized woody tissue	470	475
Gray micaceous sandstone and white limestone. A little dark shale	475	480
Gray sandy shale and yellow limestone	480	485
Gray sandy shale and white limestone. Some yellow limestone	485	490
Sandstone with infiltrated calcite, white limestone, and a few small spherical siderite concretions	490	495
Gray micaceous sandy shale, some yellowish limestone, white sandstone and a little dark shale	495	505
White sandstone, some dark shale, and yellow limestone	505	515
Dark gray shale	515	520
Dark shale, fire clay and some white limestone	520	525
Dark gray shale	525	530
Dark limestone, some dark shale, crinoid stems and some other organic material noted. Tuberculated crinoid spine like that in F. G. McCleave well at 505 to 510 feet. *Fusilina* present	530	535
Like the preceding	535	540
Dark limestone, coal, some yellow limestone and several crinoid stems noted	540	545
Gray micaceous sandstone and a few pieces of coal	545	550
Gray micaceous sandstone, a few bits of coal and siderite	550	555
Gray micaceous shaly sandstone, some siderite and a little limestone	555	560
Gray shale	560	565
Dark gray shale	565	570
Gray shale, some siderite and bits of pyrite	570	575
Gray shale and a little coal	575	580
Black shale and gray micaceous shale	580	585
Black micaceous shale and gray sandstone	585	590
Gray micaceous sandy shale and some black shale	590	595
Gray micaceous shale and black shale	595	600
Gray micaceous sandy shale and a little black shale	600	605
Gray micaceous sandstone and some siderite	605	610
Gray micaceous shale, some sandstone and siderite	610	615
Dark micaceous shale	615	620
Gray micaceous shale with shreds of vegetation	620	625
Gray sandy shale	625	635
Gray shale	635	640
Dark gray shale and some siderite	640	645
Dark gray shale, some siderite and yellow limestone	645	650
Dark shale and siderite concretions	650	655
Dark shale, some siderite and a little white limestone	655	660
Gray shale	660	670
Gray sandstone, a few bits of pyrite and siderite	670	680
Gray sandstone	680	685
Gray sandy shale	685	690
Dark shale and gray sandy shale	690	695
Dark gray shale and some siderite	695	710
Dark gray shale	710	715
Dark shale and some siderite	715	725
Dark shale and a little siderite	725	735
Dark shale, a little white sandstone	735	745
Dark shale and concretionary siderite	745	755
Dark shale	755	760
Black shale	760	765
Black shale and some sandstone	765	770
Gray micaceous sandstone and a little black shale	770	775
Gray shale and micaceous sandstone	775	780
Gray micaceous shale and a little sandstone	780	785
Coal and gray shale	785	790
Gray shale, some fire clay, a little coal and bits of pyrite	790	795
Gray shale and some gray micaceous sandstone	795	800
Gray micaceous sandy shale and some gray shale	800	810
Gray micaceous shale	810	820
Gray sandy micaceous shale	820	825
Gray shale and concretionary siderite	825	830
Coal	830	835
Black carbonaceous shale and some gray shale	835	840
Black shale, gray sandstone and a little coal	840	845

Description of samples from well on the Drake farm—Concluded.

	Depth in feet. From.	To.
White sandstone and a little white limestone	845	850
Dark shale and some white sandstone with infiltrated lime	850	860
Dark shale, white sandstone, with infiltrated lime, some small spherical siderite concretions and bits of pyrite	860	865
Dark shale, white micaceous sandstone and bits of coal	865	870
White micaceous sandstone	870	875
Dark shale and white micaceous sandstone	875	880
Black micaceous shale, white sandstone and some siderite concretions	880	885
Gray micaceous shale	885	890
Hard black shale and a few pieces of white limestone	890	895
Gray sandstone and black shale, small spherical siderite concretions and bits of pyrite	895	900
Black shale	900	905
Black shale and a very few pieces of white limestone	905	910
Black micaceous shale, a little white limestone and a few bits of coal	910	915
Black micaceous shale and a little limestone	915	920
White sandstone and dark shale	920	930
White micaceous sandstone containing carbonaceous shreds and a little black shale	930	935
Dark shale and some white micaceous sandstone	935	955
Like the preceding, with a few bits of coal	955	960
Dark micaceous shale	960	965
White micaceous sandstone, some shale and a few bits of limestone	965	975
Gray micaceous shale, black shale and some sandstone	975	980
Gray shale and some sandstone	980	985
White micaceous sandstone and some dark shale	985	995
Gray micaceous sandy shale and a few pieces of white limestone	995	1,005
Gray shale and some sandstone	1,005	1,010
Gray shale	1,010	1,020
Black shale and a little gray sandstone with infiltrated lime	1,020	1,030
Gray micaceous shale, some grayish green pieces of shale and a few bits of limestone	1,030	1,045
Dark shale and a little sandstone	1,045	1,050
Dark shale	1,050	1,055
Yellow micaceous sand	1,055	1,060
Yellow micaceous sand and some dark shale	1,060	1,065

33. WELL NO. 21, ON FARM OF J. C. WILSON, ROBINSON TOWNSHIP, CRAWFORD COUNTY.

Well No. 21 on the J. C. Wilson farm is operated by the Ohio Oil Company. It is situated in the W. ½ NW. ¼ sec. 17, T. 7 N., R. 12 W., Robinson Township, Crawford County. Its elevation is estimated to be 490 feet above sea level. Its entire section is in the Pennsylvanian. *Fusulina* was found in the sample from 540 to 545 feet, which represents the horizon of coal No. 6.

Description of samples from well No. 21 on the Wilson farm, Robinson Township, Crawford County, Illinois.

	Depth in feet. From.	To.
Dark gray shale, fine in texture	200	205
Gray shale, fragments of concretions, and coal	205	210
Shale, sandy, micaceous, light gray	210	215
Micaceous sandstone, light, gray and fine-grained	215	220
Gray micaceous sandy shale	220	225
Laminated, dark and light gray, micaceous shale	225	230
Gray, stony shale	230	235
Like the preceding	235	240
Like the preceding	240	245
Black shale and some gray shale	245	250
Gray shaly sandstone, with infiltrated lime	250	255
Gray sandstone and shale	255	260
Gray sandstone, some limestone	260	265
Gray sandy shale, some limestone	265	270
Gray sandy shale and concretionary siderite, some limestone	270	275
Dark gray shale	275	280
Gray sandstone and yellowish sandstone with infiltrated calcite	280	285
Coarse white sandstone, yellow micaceous sandstone, and some gray shale	285	290

Description of samples from well No. 21—Continued.

	Depth in feet. From.	To.
Coarse white sandstone and gray shale	290	295
White sandstone, some micaceous sandstone, little dark shale and limestone	295	300
Gray micaceous sandy shale, some gray shale	300	305
Gray micaceous sandy shale	305	310
Gray micaceous shale	310	315
Gray micaceous shale	315	320
Gray micaceous shale, some fragments of limestone	320	325
Dark gray shale, a few bits of limestone	325	330
Dark gray shale, and a few fragments of limestone, and siderite	330	335
Gray shale, siderite concretions, some bits of limestone and pyrite	335	340
Dark gray and black shale	340	345
Gray shale, limestone and siderite concretions; some quartz grains	345	350
Gray micaceous sandy shale and black micaceous shale, and a few bits of limestone	350	355
Gray micaceous and sandy shale	355	360
Dark gray shale	360	365
Dark gray shale	365	370
White organic limestone, brecciated. Crinoid stems, *Rhombopora lepidodendroides, Athyris* (?), and fragments of other brachiopods noted, one with peculiar finely reticulated structure	370	375
Yellowish gray limestone, organic breccia	375	380
Red shale and gray shale, with some black shale	380	385
Fire clay, some fragments of coal and green shale	385	390
Greenish gray shaly sandstone	390	395
Greenish gray shaly sandstone, with some limestone	395	400
Light gray micaceous shale	400	405
Light gray sandy shale	405	410
Dark gray stony shale	410	415
Like the preceding	415	420
Like the preceding	420	425
Micaceous gray sandy shale, with a few fragments of coal	425	430
Micaceous sandy shale and shaly sand, laminated; showing shreds of vegetation	430	435
Laminated sandstone, shaly, carbonaceous	435	440
Micaceous sandy gray shale, with bits of carbonaceous shreds	440	445
Gray shaly sandstone with carbonaceous layers	445	450
Dark and light sandy shale, laminated	450	455
Like the preceding	455	460
Gray shaly sandstone, coal, and some calcite from a joint in the coal	460	465
Greenish gray shaly limestone of compact texture	465	470
Sandy shale and gray and yellow limestone	470	475
Gray micaceous sandstone, with some limestone	475	480
Sandstone with concretionary impregnations of yellow limestone	480	485
Dark, almost black, stiff shale	485	490
Black limestone, organic	490	495
Coal	495	500
Black shale, with imprints of leaves	500	505
Coal, some shale	505	510
Limestone and some micaceous shaly sandstone	510	515
Coarse white sandstone, pyrite, and some white brecciated limestone	515	520
Micaceous coarse sand	520	525
Micaceous, coarse sand, with some gray shale and limestone	525	530
White micaceous sandstone	530	535
White micaceous sand, and some coal and limestone	535	540
Dark blotchy brown limestone, with *Chonetes, Productus, Fusulina, Rhombopora, Fistulipora,* crinoid stems, some coal and some black carbonaneous shale	540	545
Micaceous and carbonaceous gray shale	545	550
Dark blotchy limestone with crinoid joints	550	555
Coal	555	560
White sandstone, speckled with minute crystals of pyrite and some dark shale	560	565
White, micaceous and pyritiferous sandstone. Some black "clod," with an *Athyris* valve	565	570
No sample	570	575
Gray sandstone with concretions of siderite and limestone	575	580
Gray shale, with concretionary material, as in proceeding sample	580	585
Dark gray shale	585	590
Dark gray shale, some sand	590	595
Black shale	595	600
Black shale	600	605
Dark shale of fine texture	605	610
Black calcareous stony shale	610	615
Black shale of finest texture	615	620
Greenish gray shaly sandstone, with pyrite crystals	620	630
Gray sandy shale and fire clay, with bituminous films in thin joints	630	635
Greenish shale, pyritiferous	635	640
Light greenish gray shale, soapstone	640	645
Gray shale and micaceous sandstone	645	650
Sandstone, gray, soft	650	655

Description of samples from well No. 21—Concluded.

	Depth in feet. From.	To.
Shaly, micaceous and laminated sandstone and black shale	655	660
Dark gray sandy shale	660	665
Like the preceding	665	670
Dark shale	670	675
Black shale	675	680
Laminated sandy shale	680	685
Greenish gray, stony shale	685	690
Black shale, with coal, considerable pyrite and frequent fragments of pyritized woody tissue	690	695
Black and gray shale, stony and sandy	695	700
Gray sandy shale	700	705
Dark shale of fine texture	705	710
Like the preceding	710	715
Gray sandy rock, with some coal and some pyrite and minute spherical concretions of siderite	715	720
Black carbonaceous shale and coal, some dark limestone. Some pieces of coal show woody structure	720	725
Dark limestone and black shale, crinoid stems and pieces of pyrite	725	730
Black shale	730	735
Dark sandy shale, little fire clay and limestone (yellow)	735	740
Black sandy micaceous shale	740	745
Coal, some black sandy shale and pyritized woody tissue	745	750
White micaceous sand, coal and some fire clay	750	755
No sample	755	760
White sand with bits of yellow limestone	760	765
Gray sandstone, some yellow limestone and black shale	765	770
Dark gray shale and limestone, some sandstone and bits of pyrite	770	775
Black shale, some dark limestone and pyrite fragments	775	780
Black shale, some pyrite	780	785
Dark gray shale	785	790
Gray sandy shale, few pieces of siderite concretions	790	795
Gray sandstone end bits of siderite	795	800
Gray sandy micaceous shale	800	805
White micaceous sandstone, gray micaceous sandy shale, little limestone, and some red fragments	805	810
White micaceous sandstone, some gray sandy shale, and red fragments	810	815
White sandstone, some dark shale	815	820
White sandstone, some dark shale	820	825
White sandstone, some dark shale, and red material	825	830
White micaceous sandstone, some dark shale	830	835
White sandstone	835	840
White micaceous sandstone, with a little gray shale and red material	840	845
Dark sandy shale	845	850
Black micaceous shale, with some yellow coarse-grained sandstone	850	855
Yellow sandstone, coarse grained, and some black shale	855	860
Gray sand, a little black micaceous shale	860	865
Gray sand, a little black micaceous shale	865	870
Black micaceous shale and some gray sand	870	875
Gray sandstone and some black micaceous shale	875	880
Gray sandstone and black micaceous shale	880	885

34. WELL NO. 8, ON FARM OF C. F. CURTIS, IN OBLONG TOWNSHIP, CRAWFORD COUNTY.

This is another well belonging to the Ohio Oil Company. It is located on the farm of Mr. C. F. Curtis, at the NE. cor. sec. 11, T. 7 N., R. 14 W., in Oblong Township, Crawford County. The elevation at the well mouth is estimated to be 475 feet above sea level. The entire section is in the Pennsylvanian series. *Fusulina* occurs in sample from 510 to 515 feet, and the horizon of coal No. 6 is just below this.

Description of samples from well No. 8 on Curtis's farm in Oblong Township, Crawford County, Illinois.

	Depth in feet. From.	To.
Yellow boulder clay	1	10
Boulder clay and drift gravel	10	15
Drift, gravel and sand	15	20
Drift, gravel and sand, with some boulder clay	20	25
Drift, sand and gravel	25	30

Description of samples from well No. 8—Continued.

	Depth in feet. From.	To.
Drift	30	35
Drift, sand and gravel	35	60
Drift, gravel and some sand	60	70
Drift, sand and gravel. A few bits of coal	70	75
Drift, sand and gravel	75	90
Drift, sand and gravel, with some shale	90	110
Sandy micaceous shale	110	115
Dark micaceous shale	115	120
Sandy dark gray shale	120	135
Sandstone, sandy shale and coal. Some fragments of limestone noted and some pyrite, and showing wood structure	135	140
Black shale, fire clay and coal	140	145
Gray and yellow limestone. Gray sandstone and coal with some shale	145	150
Gray sandstone, micaceous and of fine texture	150	155
Like the preceding with some siderite	155	165
Moderately coarse gray and yellow micaceous sand	165	170
Gray shale and micaceous sand	170	180
Moderately coarse micaceous sandstone	180	190
Gray, fine sandstone, and yellow concretionary limestone, in which is considerable pyrite	190	195
Gray micaceous sandy shale and concretionary siderite	195	200
Gray micaceous sandy shale, and some concretionary siderite	200	205
Gray micaceous sandy shale and a few pieces of yellow limestone	205	210
Gray, micaceous, sandy shale	210	215
Gray micaceous shale	215	220
Gray micaceous shale, a few pieces of gray sandstone, some white limestone and coal	220	225
Gray micaceous shale with imprints of vegetation, some fire clay and pieces of white limestone	225	230
Dark gray micaceous shale	230	235
Dark gray and gray micaceous shale	235	240
Dark micaceous shale	240	245
Black shale, a few pieces of sandstone, siderite, yellow limestone and pyrite	245	250
Black shale and coal, some pure calcite and white limestone	250	255
Black shale and coal, some dark limestone and gray sandstone	255	260
Darkish gray limestone (nodular in structure), some coal, gray sandstone and bits of pyrite	260	265
Gray shale, concretionary yellow limestone, some white limestone, some gray sandstone, and some black coaly shale	265	270
Yellowish limestone, some gray limestone, gray sandstone, some concretionary sandstone, a little coal and pyrite	270	275
Greenish gray stony shale, with a few very thin laminae of coal	275	280
Gray micaceous stony shale	280	290
Dark gray stony shale	290	295
Dark greenish gray shale of fine texture	295	305
Dark shale of fine texture	305	310
Gray sandstone, brown concretionary siderite, gray shale, black shale, gray limestone, crinoid stems and a few fragments of coal	310	315
Gray shale and grayish brown fossiliferous limestone, with crinoid stems, brachiopod spines, pieces of shells, etc.	315	320
Gray shale, concretionary brown siderite, some sandstone and coal. The limestone contains organic fragments. The coal is impure and shows very thin lamination	320	325
Gray sandstone containing shreds of carbonaceous material and pyrite, with some shale	325	335
Light gray thin bedded micaceous sandstone, some pieces with infiltrated calcite	335	345
Mostly a grayish limestone containing some fine siliceous material, with some yellow and some white limestone and some black shale	345	350
Gray limestone and some gray sandy lime, showing occasional obscure fragments of fossils	350	355
Gray limestone and white limestone with waxy lustre	355	360
Greenish gray micaceous and sandy shale and some limestone	360	380
Greenish gray shale of somewhat fine texture	380	385
Dark gray shale of somewhat fine texture	385	395
Gray shale	395	400
Dark, almost black, micaceous shale, showing narrow veins impregnated with thin green films of pyrite	400	405
Black shale with shreds of carbonaceous vegetation. Some gray shale and some siderite	405	410
Gray shale with carbonaceous shreds, some black coaly shale. A few pieces of siderite noted	410	415
Gray and black coaly shale and gray sandstone	415	425
Gray sandstone, some gray shale and pieces of siderite	425	435
Gray micaceous sandy shale, some gray shale and concretionary siderite	435	440
Dark gray shale	440	445
Dark gray shale and concretionary siderite	445	455
Dark gray shale, with imprints of vegetation, and some siderite	455	460

Description of samples from well No. 8—Concluded.

	Depth in feet. From.	To.
Gray shale with imprints of vegetation. Some siderite and some carbonaceous shale	460	465
Gray sandstone and white limestone, some fragments of coal and of concretionary siderite	465	475
Gray micaceous shale, some yellow concretionary siderite, a little limestone and gray shale	475	480
Gray micaceous sandy shale, some yellow limestone and siderite	480	485
Dark gray sandy micaceous shale, some gray shale, concretionary siderite and some gray sandstone	485	490
Dark micaceous shale	490	495
Dark gray micaceous shale and some siderite	495	500
Black limestone, some black shale, and some siderite. Crinoid stems noted	500	505
Black limestone, some black shale, some coal and siderite. Crinoid stems noted	505	510
Black limestone, some black shale, coal and siderite. A *Fusilina*, a lamellibranch (?) shell; *Aviculopecten carboniferous;* a minute gasteropod and some crinoid spines and stems noted. The limestone yields bituminous and sulphurous odors when heated	510	515
Dark limestone, some pieces impregnated with small particles of pyrite, some coal and black shale, some siderite and fragments of white limestone and calcite	515	520
Black limestone, a few pieces of coal, pyrite, siderite, white limestone and crinoid stems	520	525
Gray micaceous sandstone, some black limestone, coal and gray shale with pyrite, siderite, and white limestone	525	530
Gray micaceous sandstone	530	550
White micaceous sandstone with some concretionary limestone and bits of coal	550	555
White micaceous sandstone and coal, with some fire clay, siderite, white limestone, much pyrite, and some calcite. *Productus, Edmondia nebrascensis* (?), *Hemipronites crassus, Chonetes punctatus* (?), some small gasteropods, several crinoid spines and stems and a bryozoan like *Rhombopora* noted	555	560
Gray sandstone and coal, with some white limestone, pyrite calcite, shale and a few crinoid stems	560	565
Dark gray shale, some coal, sandstone, pyrite and fire clay	565	570
Gray micaceous sandstone, with a little fire clay and shale	570	575
Gray micaceous sandstone, some of which is studded with spherules of pyrite measuring from 1 to 3 mm. in diameter, and showing faces of small cubic crystals on the surface	575	585
Gray micaceous shale	585	610
Gray micaceous shale and some siderite	610	615
Dark gray shale	615	620
Gray shale and some yellow limestone, concretionary siderite in large fragments and in minute spherules, coal and some sandstone	620	625
Gray micaceous shale, a little yellow limestone, siderite, pyrite and coal	625	630
Gray micaceous sandstone and shale with siderite, fire clay and coal	630	635
Gray micaceous sandstone and some shale	635	640
Gray micaceous sandstone	640	645
Gray micaceous sandstone, with some siderite	645	650
Gray micaceous shale and some yellow limestone, and fire clay	650	655
Dark gray shale, some fire clay and concretionary siderite	655	660
Dark gray micaceous shale, a little yellow limestone and siderite	660	675
Dark gray micaceous shale	675	680
Dark gray and some micaceous black shale, with a little siderite	680	685
Dark shale, with imprints of vegetation, and some fire clay	685	690
Dark shale and concretionary siderite	690	695
Dark micaceous shale and some siderite	695	700
Dark gray micaceous shale	700	715
Gray micaceous shale and some sandstone	715	725
Gray laminated sandstone and black shale	725	730
Dark shale, concretionary siderite and a little sandstone	730	735
Hard black shale	735	740
Black shale, some coal and sandstone and a little siderite	740	745
Gray micaceous shale, some yellow limestone, some black shale and a few bits of coal	745	750
Black shale and a few fragments of yellow limestone and coal	750	755
Black micaceous shale	755	760
Coal and a few pieces of black shale	760	765
Coal and black shale, some white limestone, a little sandstone, siderite and bits of pyrite	765	770
Gray sandstone, some dark shale, bits of coal and limestone	770	775
Gray micaceous sandstone and a little yellow limestone	775	790
Dark micaceous shale and a little siderite	790	795
Black shale and a little coal. A little gray limestone noted	795	800
Black shale, a little coal and a little sandstone	800	805
Dark pyritiferous shale and some gray sandstone	805	815
Gray micaceous shale	815	820
Gray micaceous shale and a few bits of coal	820	825

35. WELL NO. 7, ON FARM OF MATTHEW SHILTZ, OBLONG TOWNSHIP, CRAWFORD COUNTY.

This well was drilled for the Ohio Oil Company on the SE. ¼ sec. 7, T. 7 N., R. 14 W., Oblong Township, Crawford County. The elevation of its curb is 485 feet above sea level. The entire section is in the Pennsylvanian. The horizon of coal No. 6 is at about 585 feet below the surface.

Description of samples from well No. 7, on Shiltz farm.

	Depth in feet. From.	To.
Light gray micaceous sandstone or sandy shale. The laminae are from 1/20-1/8 in. thick	185	190
Gray micaceous shaly sandstone, with carbonaceous foliations showing leaf fragments and needle-like impressions. Biotite scales noted	190	195
Like the preceding	195	200
Gray micaceous shaly sandstone and black carbonaceous shale	200	205
Gray micaceous shaly sandstone, with carbonaceous foliations	205	210
Gray calcareous limestone, partly organic fragmental, apparently concretionary. A fragment of a black silicified piece of a fern stem noted	210	215
Light gray sandy shale, micaceous	215	220
Gray sandstone, fine in texture, and with a calcareous matrix	220	225
Like the preceding	225	230
Light gray, sandy shale	230	235
Like the preceding	235	240
Like the preceding	240	245
Like the preceding	245	250
Light gray sandy and micaceous shale and some calcareous concretionary material	250	255
Dark micaceous shale and micaceous gray sandstone	255	260
Gray, stony shale	260	265
Black fissile shale (miner's slate), and greenish fire clay	265	270
Gray sandy shale and black shale	270	275
Greenish gray shale of fine texture	275	280
Light gray shaly sandstone and shale, biotitic	280	285
Light gray sandy and micaceous shale, with some dark and soft, marly material	285	295
Gray sandy shale	290	295
Dark gray sandy shale	295	300
Dark gray sandy and micaceous, stony, shale	300	305
Like the preceding	305	310
Like the preceding	310	315
Like the preceding	315	320
Dark gray stony shale and green fire clay	320	325
Dark gray shale of fine texture	325	330
Like the preceding	330	335
Dark shale, with impressions of narrow leaf-like forms of vegetation and of fragments of thin shells	335	340
Miner's slate, black, and some coaly shale	340	345
Gray sandstone, moderately coarse	345	350
Light gray sandy shale with layers of shaly sandstone which contains spherules of brown siderite	350	355
Gray calcareous limestone	355	360
Gray limestone and some black shale. *Chetetes milleporaceus* noted	360	365
Micaceous gray sandy shale or sandstone with some concretionary limestone	365	370
Gray micaceous sandstone and sandy shale	370	375
Like the preceding	375	380
Gray, soft shaly sandstone. Some fragments have a brownish tint	380	385
Like the preceding	385	390
Gray fine-grained shale	390	395
Gray sandy shale, light	395	400
Micaceous and sandy, stiff shale, light gray, with narrow impressions, carbonaceous, of small leaves and bits of brown tests of crustacea. Many fragments of coal	400	405
Medium gray stiff shales of fine texture, with many fragments of coal	405	410
Gray shale of fine texture, with fossil fragments	410	415
Shale, sandy, micaceous, greenish gray, with loaf imprints	415	420
Shale, sandy, micaceous, and greenish gray, with small black fragments of vegetation	420	425
Sandstone, fine in texture, micaceous, shaly, light gray	425	440
Gray shale of fine texture, greenish, only very slightly micaceous	440	445
Sandy shale, gray, micaceous, with bits of vegetation	445	450
Light gray shale, stony	450	455

Description of samples from well No. 7—Continued.

	Depth in feet. From.	To.
Shale, greenish gray, micaceous	455	470
Dark greenish gray shale, of fine, even texture	470	475
Coal and fine gray shale and fire clay	475	480
Limestone, some dark and compact, with very slow effervescence, some light, calcareous, with crystalline cleavage like that in crinoid stems. Also some limestone and shale, with small spherules of clay ironstone, magnetic after fusion, .125 mm. to .5 mm. in diameter. Wood in coaly pyrite	480	485
Shaly sandstone of light gray color	485	495
Dark gray, stony, micaceous shale	495	500
Gray sandstone and shale	500	505
Gray shale, stiff, fine textured	505	510
Dark gray micaceous shale	510	515
Gray dark shale, stiff, micaceous	515	520
Gray limestone and coal, limestone is organic fragmental. Crinoid joints noted	520	525
Coal and some gray fire clay	525	530
Gray sandstone with a little micaceous shale	530	540
Gray sandstone and sandy shale	540	545
Gray sandstone, fine textured	545	555
Gray, micaceous, stony (sandy) shale	555	570
Gray shaly fire clay or shale	570	575
Dark shale and a little coal. Shale is fine and carbonaceous	575	580
Black limestone, effervescing slowly, with embedded organic fragments and pyrite. Green grains, or fillings, in limestone; crinoid stems; fragments of shells; and spines of brachiopods; *Fusulina* noted	585	590
Dark gray, stiff, micaceous shale	590	595
Gray micaceous shaly sandstone and shale	595	600
Shaly sandstone, gray, micaceous	600	605
Dark calcareous limestone, with *Athyris*, crinoid stems and spines in many fragments, and coal, in coarse and fine fragments	605	615
Gray sandstone and black shale	615	620
Gray sandy shale	620	625
Sandstone, light gray, fine textured, thinly laminated, and some yellow concretionary material	625	630
Gray shaly sandstone, micaceous	635	640
Gray sandy shale and fire clay	640	645
Gray sandy shale	640	650
Gray shale, fine textured	650	660
Gray sandy shale with straight laminations	660	665
Black shale, with gray blotches, laminated (miner's slate)	665	670
Black shale, and dark gray shale	670	675
Light greenish gray shale of fine texture	675	680
Like the preceding	680	685
Black shale, almost slaty	685	690
Black stiff shale of fine texture	690	695
Dark gray shale	695	700
Gray sandy shale	700	705
Gray stiff shale, and some earthly shale	705	710
Dark gray earthly shale and light gray sandstone	710	715
Dark gray laminated shale	715	725
Dark gray, laminated, micaceous shale, with imprints of leaves and bits of vegetation	725	730
Gray shale, sandy and micaceous, with imprints of fragments of leaves	730	735
Very dark shale, micaceous	735	740
Black shale (miner's slate)	740	745
Like the preceding, with pyrites	745	750
Gray sandstone, with some coal	750	755
Sandstone and laminated, dark gray shale	755	760
Dark gray shale	760	765
Shale, dark gray, some dark fire clay, coal	765	770
Coal, hardly anything else, large sample	770	775
Light gray, sandy, fire clay and coal	775	780
Light gray, micaceous, pyritiferous sandstone, and some dark shale	780	785
Light gray micaceous sandstone	785	790
Micaceous light gray sandstone	790	795
Sandy gray shale and fire clay, dark, and showing slickensides	795	800
Dark gray shale, fine in texture, with some slickensided pieces	800	805
Black miner's slate	805	810
Black, coaly shale, with a light gray rock composed of clay and containing small spherules of clay ironstone, .25 mm. to .5 mm. in diameter	810	815
Dark gray shale with some fine small flakes of mica	815	820
Coal and some dark shale, with fragments of brown clay ironstone	820	825
Fire clay, shale, dark and light gray sandstone	825	830
Dark gray shale and shaly light gray sandstone	830	835
Black shale, coal and fire clay	835	840
Gray sandy shale and black shale, some coal	840	845
Gray sandy shale, black shale, some coal	845	850
Black and gray shale, laminated	850	855
Dark gray shale, micaceous, and sandy, light gray shale	855	860

Description of samples from well No. 7—Concluded.

	Depth in feet. From.	To.
Black shale and gray shale, micaceous; imprints of leaves	860	865
Gray and black shale, some of the black shale with thin laminae of coal	865	870
Gray micaceous and sandy shale and shaly sandstone	870	875
Black coaly shale (miners slate), some impure coal, and some fire clay	875	880
Dark gray shale, stiff	880	885
Some gray shale, some shaly sandstone, some "cloddy" limestone with crinoid stems and other fossils in fragments. Much of the sample is a stony, sandy fire clay, in which are embedded spherules of clay ironstone .125 mm. to .5 mm. in diameter. On grinding some fragments containing these spherules a centre of pyrite was seen in some. The embedded spherules lie quite close together, giving the appearance of an oolitic rock	885	890
Gray micaceous sandy shale and fire clay	890	895
Gray shaly, micaceous, sandstone, or sandy shale	895	900
Like the preceding	900	905
Gray shaly, micaceous, sandstone	905	910
Gray sandstone, with carbonaceous, black foliations	910	915
Like the preceding	915	920
Yellowish sandstone, grains float on water	920	925
Gray sand, less oily, .125 mm. to .25 mm. in diameter	925	950

36. WELL NO. 15, ON FARM OF O. F. EDWARDS IN OBLONG TOWNSHIP, CRAWFORD COUNTY.

This well, which is also operated by the Ohio Oil Company, is located on the farm of Mr. O. F. Edwards in the SE. ¼ sec. 7, Oblong Township, Crawford County. The elevation of its curb is 485 feet above sea level.

Description of samples from the Edward well No. 15.

	Depth in feet. From.	To.
Loess or silt, with some sand	0	5
Boulder clay, thoroughly leached	5	10
Like the preceding	10	15
Yellow boulder clay, calcareous	15	20
Yellowish gray calcareous boulder clay, with limestone pebbles	20	25
Sand and gravel, washed from boulder clay	25	30
Sand and gravel, washed from boulder clay	30	35
Like the preceding	35	40
Gray boulder clay	40	45
Sand and gravel, washed from boulder clay	45	50
Mostly sandstone, fairly coarse, with some limestone fragments of fossils, probably *Productus semi-recticulatus, Retzia, Rhombopora lepidodendroides, Fistulipora, Tubipora,* and joints of crinoid stems	50	55
Sandstone, gray micaceous, friable	55	60
Like the preceding	60	65
Gray friable shale, slightly micaceous	65	70
Like the preceding	70	75
Like the preceding	75	80
Like the preceding	80	85
"Dirt bed" material, dark crumbling silt clay, with some coal	85	90
Impure fire clay and shale, much coal, and concretions of calcite and siderite	90	95
Dark shale	95	100
Gray shale, micaceous	100	105
Gray shale and marly material, containing the pygidium of a small trilobite, fragments of bryozoa, and joints of crinoid stems	105	110
Almost black shale, containing small ostracods, 1/30 inch in length and an impression of some smooth flat objects, having the shape of an equilateral triangle with perfectly straight sides measuring 1/6 inch	110	115
Black shale with impressions of fucoidal bands 1/10 inch in width. Part of sample a dark limestone with crinoid stems, a small pentagonal crinoid plate, and a small brachiopod (*Ambocoelia umbonata* ?)	115	120
Dark limestone, of characteristic appearance of "clod" limestone; clay; fissile shale and coal. The limestone has the same fossils as in the preceding	120	125
Dark limestone as above, with irregularly curved *Ammodiscus* tubes. Also coal and some fire clay. The coal probably lies at a depth of about 125 feet, and is underlain by the fire clay	125	130

Description of samples from the Edward well No. 15—Continued.

	Depth in feet. From.	To.
Gray micaceous sandstone	130	135
Like the above	135	140
Micaceous shaly sandstone and sandy shale	140	145
Micaceous shaly sandstone	145	150
Micaceous shaly sandstone and sandy shale	150	155
Coal, some "clod" and some shale	155	160
Gray micaceous sandstone	160	165
Gray micaceous sandstone, with one large piece of coal and one large piece of black shale, containing fragments of some thin shells, probably a *Lingula*	165	170
Gray sandstone, with some calcareous rock	170	175
Shaly micaceous gray sandstone	175	180
Like the preceding with some small fragments of a calcareous rock	180	185
Dark gray sandy shale with large flakes of mica	185	190
Dark gray micaceous shale	190	195
Gray micaceous shale, with shreds of vegetation	195	200
Limestone, compact, yellowish white and dark gray, containing crinoid stems and fragments of other unidentified fossils. Splits into thin fragments, and has a sort of waxy lustre	200	205
Like the preceding	205	210
Gray shale, somewhat micaceous	210	215
Fire clay, shale, and sandstone	215	220
Mostly sandstone having a calcareous matrix and a few embedded organic calcareous fragments	220	225
Sandy shale or shaly sandstone, with some black mica	225	230
Gray sandstone	230	235
Gray sandstone, laminated with thin layers of carbonaceous material	235	240
Dark gray sandstone, laminated, micaceous, with thin carbonaceous foliations, and with a calcareous cement	240	245
Sandstone, dark gray, shaly, biotitic. Some fragments show yellow specks of presumably concretionary iron carbonate; other fragments are closely studded with minute grains of pyrite	245	250
Some sandstone like the preceding, dark shale, and fire clay	250	255
Dark shale and sandstone, both biotitic	255	260
Black shale and some fragments of a coarse shell breccia containing crinoid stems	260	265
Like the preceding	265	270
Gray sandstone	270	275
Gray sandstone, with a brown, slowly effervescing sandstone	275	280
Like the preceding, with more of the brown rock, which seems to have a concretionary (oolitic) structure and consists mainly of carbonate of iron with some calcareous grains	280	285
Gray sandstone, micaceous	285	290
Like the preceding	290	295
Like the preceding, with some shaly sandstone	295	300
Gray sandstone, micaceous	300	305
Like the preceding	305	310
Gray shale	310	315
Gray shale, with small ostracod, and a spiral *Ammodiscus*	315	320
Gray shale, with narrow ribbon-shaped impressions of vegetation and with ostracods and a spiral *Ammodiscus*	320	325
Gray sandy shale and micaceous sandstone	325	330
Micaceous sandstone and coarse gray shale	330	335
Coarse sandstone	335	340
Sandstone, with yellow grains (concretionary) of carbonate of iron, larger than the sand grains	340	345
Gray shale with some very compact fragments of carbonate of lime concretions	345	350
Faintly yellowish gray limestone, splitting into thin chips, with many unrecognizable fragments of organic origin	350	355
Like the preceding	355	360
Limestone, like the preceding, with a brachiopod shell fragment, a *Zaphrentis* and joints of crinoid stems. Also some dark gray shale	360	365
Greenish gray shale	365	370
Gray micaceous sandstone and shale	370	375
Like the preceding	375	380
Like the preceding	380	385
Gray shale, fine textured	385	390
Gray shale, fine textured	390	395
Bluish gray sandstone	395	400
Shale, mostly dark gray, and of fine texture	400	405
Sandstone and sandy shale	405	410
Micaceous sandstone and shale	410	415
Gray silty shale	415	420
Dark gray shale	420	425
Gray sandstone and shale	425	430
Gray shale and some impure coal	430	435
Micaceous gray shale, with fragments of concretions of siderite	435	440
Gray shale	440	445
Gray shale, or fire clay	445	450
Gray shale, stony and dark, micaceous	450	455

Description of samples from the Edward well No. 15—Continued.

	Depth in feet. From.	To.
Some gray shale like the above. But mostly a dark dirty yellow clay too oily to mix with water, giving off gas and oil when heated and losing much of its weight on ignition, probably 30 or 40 per cent..	455	460
Like the preceding, with much coal	460	465
Sandstone, gray, micaceous, and some pieces of a black limestone, containing fragments of fossils	465	470
Oily clay, like that above, with coal and gray stony shale and some pyrite	470	475
Like the preceding, with much coal and some fossiliferous limestone..	475	480
Sandstone, with some yellow limestone containing organic fragments..	480	485
Gray shale and some sandstone	485	490
Dark gray shale	490	495
Dark gray shale	495	500
Dark gray shale with a small *Ammodiscus* and some narrow fucoid markings	500	505
Gray limestone with embedded yellow fragments of fossils with some black shale and coal	505	510
Mostly fire clay and coal	510	515
Sandstone, some coarse, some thinly laminated	515	520
Sandstone, comparatively coarse	520	525
Sandstone of average texture	525	530
Sandstone	530	535
Dark arenaceous shale	535	540
Shaly sandstone, black shale and coal	540	545
Some coal, fire clay, and dark sandy shale	545	550
Mostly coal, some black shale and fire clay	550	555
Gray sandstone, with a compact yellowish gray limestone, breaking frequently into rectangular fragments, and probably of concretionary origin	555	560
Dark shale and sandy gray shale with fragments of concretions of siderite	560	565
Gray shaly sandstone	565	570
Dark "cloddy" shale and coal, with some sandstone	570	575
Coal, stony fire clay and sandy shale	575	580
Gray sandy shale	580	585
Shaly sandstone	585	590
Shaly sandstone, greenish sandy shale, coal and concretionary siderite	590	595
Like the preceding	595	600
Gray shale	600	605
Dark gray shale, hard	605	610
Like the preceding	610	615
Dark gray shale	615	620
Like the preceding	620	625
Like the preceding	625	630
Dark gray shale with a fine textured and compact limestone, in part gray, in part yellow, apparently concretionary	630	635
Gray shale, with concretionary limestone like that in the above	635	640
Gray sandstone and some black shale	640	645
Gray fine-grained sandstone, with some black coaly shale	645	650
Like the preceding, but with less shale	650	655
Gray shale and black shale	655	660
Gray shale	660	665
Black micaceous shale and gray shale, with concretionary material..	665	670
Black micaceous shale with concretionary material	670	675
Gray and black shale and coal	675	680
Coal and gray shale	680	685
Gray shaly and micaceous sandstone with much carbonaceous material, and with imprints of vegetation abundant in some fragments	685	690
Dark gray sandstone of fine texture with thin layers of carbonaceous material	690	695
Dark gray micaceous shale with imprints of fern leaves	695	700
Dark gray shale, micaceous	700	705
Dark gray shale, micaceous, stony	705	710
Like the preceding	710	715
Like the preceding	715	720
Like the preceding	720	725
Black shale, hard	725	730
Black shale	730	735
Black shale, with "clod" limestone containing a crinoid stem; some coal	735	740
Gray micaceous sandstone, comparatively coarse in texture	740	745
Gray sandstone	745	750
Shale, almost black	750	755
Black shale and coal	755	760
Black shale and fragments of "clod" limestone, coal and fire clay...	760	765
Like the preceding	765	770
Gray micaceous sandstone, with brown concretionary material	770	775
Gray sandstone and dark shale	775	780
Gray shale and some sandstone	780	785
Gray sandstone and shale, with much brown concretionary material...	785	790

Description of samples from the Edward well No. 15—Concluded.

	Depth in feet. From.	To.
Like the preceding, with some calcareous material	790	795
Gray shale, and some fire clay with thin carbonaceous flakes embedded	795	800
Dark gray shale, micaceous	800	805
Like the preceding	805	810
Shale, almost black	810	815
Like the last	815	820
Black and gray shale, some "clod" limestone, some fire clay and some concretionary carbonate of lime	820	825
Black clay, shale, some coaly shale, some brown and soft concretionary material	825	830
Dark bluish shale and some sandstone	830	835
"Clod" limestone, dark and black shale, coal and greenish shaly fire clay	835	840
Bluish gray shaly fire clay and black shale	840	845
Gray fire clay and some coal	845	850
Black shale, gray shale and sandstone	850	855
Gray shale and shaly sandstone	855	860
Black shale and coal, with some concretionary siderite	860	865
Like the preceding	865	870
Like the preceding	870	875
Black shale and gray shale with much concretionary siderite and some coal	875	880
Dark gray shale, with concretionary siderite	880	885
Dark gray shale, with much concretionary siderite	885	890
Black, micaceous shale	890	895
Black shale, slightly micaceous	895	900
Mostly black shale, with some concretionary material	900	905
Thinly laminated shale with alternate light and dark layers	905	910
Dark gray, stiff shale	910	915
Dark gray shale, laminated	915	920
Laminated shale, with sandy laminae about 1/64 in. in thickness	920	925
Like the preceding, but with sandy layers, thicker	925	930
Like the preceding	930	935
Like the preceding	935	940
Coaly black shale and gray shaly sandstone, both micaceous	940	945
Black shale, greenish gray shale, and sandstone	945	950
Crumbly gray sand, some 70 per cent of the grains measuring from .125 mm. to .25 mm. in diameter. Some 20 per cent measuring less than .125 mm., and only a few measuring more than .25 mm. The sand floats on water	950	955
Black shale	955	960
Black shale, brownish concretionary siderite and some sand	960	965
Gray faintly brownish sand which floats on water, with some coherent lumps, which emit oil when heated	965	970
Thinly laminated shale sandstone, alternate laminae of dark and light material. Laminae mostly about .5 mm. in diameter. Slightly effervescent with acid	970	975
Like the preceding, but more shaly with fewer laminations	975	980
Dark stony shale, with thin layers of alternating light and dark material, with some concretionary brownish carbonate of iron	980	985
Sandy laminated shale or shaly sandstone, layers bended and curving	985	990

Samples taken every 5 feet for the entire depth of the well were submitted for examination. All have the general appearance of the deposits of the Pennsylvanian series in this region. An oily clay, containing a considerable percentage of bituminous material, and of a yellow color, occurs at a depth of 455 to 465 feet, and again at a depth of 470 to 475 feet. There is a sufficient quantity of oil in this clay to prevent its mixing with water, to render it soft, coherent, and decidedly plastic, to make faint grease spots on the paper bags in which the samples were kept, and to distil readily from the clay in quantities sufficient to support a flame in an open receptacle. Two limestones appear in the upper part of the section, one at the depth of 200 feet and the other at the depth of 360 feet. The latter is probably to be correlated with a limestone horizon which occurs at about 160 feet above coal No. 6, in the Belleville region, and the former is most likely the equivalent

of the Carlinville limestone, about 150 feet higher up in the section. coal No. 6 is believed to be either the coal at 477 feet or else the coal at 510 feet, most probably the latter. The number of coal seams penetrated is no less than fourteen or fifteen, and they fall into three groups, the lower group consisting of five coals, probably in thin beds, including those between 670 and 850 feet in depth. This group probably includes coals No. 1 and No. 2 of Northern Illinois. The middle group comprises the coals from 430 to 580 feet below the surface and no doubt includes coal No. 6. The uppermost group, comprising some small coals of the upper "Coal Measures" of Worthen, are the coals in the upper 200 feet of the section. The sandy shale in the lower part of the section, which contains the oil-sand, exhibits a quite persistent lamination of thin dark and light layers. It is believed that this feature may be useful in its identification in the nearest outcrops. This part of the section probably belongs to the Pottsville.

37. CRAIG AND LOWRIE'S TEST WELL, ROBINSON, CRAWFORD COUNTY.

The Craig and Lowrie test well, at Robinson, is located on W. T. Highsmith's farm, in the NE. ¼ sec. 14, T. 7 N., R. 12 W. 2½ miles southeast of Robinson, Crawford County.

Some cuttings were submitted for examination from the lower part of this well extending from 1,576 to 1,940 feet in depth. All the samples are evidently from the Mississippian. The cherty rock at 1,710 and 1,740 may be from the Burlington and the brown rock in the lowest three samples may be from the Kinderhook, but the samples give no certain evidence that such is the case.

Description of samples from well at Robinson, Illinois.

	Depth in feet.
Light gray limestone, effervescing slowly for a calcareous rock. A small unrecognizable fragment of some fossil was noted. One-fourth of the material was dark gray shale	1,575
Light gray, or white limestone, effervescing slowly for a calcareous rock. Some dark shale	1,585
The largest fragments consist of dark shale. There is also some bluish green shale. Most of the sample is a finely ground and highly effervescent limestone with a shaly matrix. The limestone has widely scattered bright green specks. Some is dark gray and fragmental. Oolitic spherules are plentiful. They range from .125 mm. to .5 mm. in diameter. They are oblate, prolate, flattened prolate, and spheroid in form, occasionally united in clusters. The limestone has occasional specks of pyrite. A crinoid stem was noted. The rock is decidedly Mississippian in aspect	1,600
White and grayish white calcareous limestone	1,640
Grayish white limestone, effervescing very briskly with acid. Occasional spherules present, showing incrustations. A small fragment of some shell noted. Some greenish shale of very fine texture, and capable of breaking into sharp splinters	1,650
Yellowish gray oolitic limestone, with spherules mostly from .1 to .3 mm. in diameter. Some dark greenish black, shale present. Some cubic pyrite noted	1,655
Light straw-colored dolomitic limestone, consisting of crystals mostly from .06 mm. to .125 mm. in diameter	1,690
Like the preceding	1,700

Description of samples from well at Robinson—Concluded.

	Depth in feet.
Dark gray calcareous limestone, with some white chert, some black shale, and some dolomitic limestone. The latter evidently from above. A joint of a crinoid stem noted	1,710
Gray dolomitic limestone of fine texture. Some fragments are chert and some gypsum, as shown by hardness, fusibility and test for sulphur	1,740
Gray calcareous limestone. Some fragments consist of accretions of spherules .25 mm. in diameter. Some spines of brachiopods, sponge spicules (?), and other fossil fragments were noted in the finest material. Bryozoa noted	1,825
Brownish gray calcareous limestone with some crinoid joints	1,895
Brownish gray calcareous limestone, with some oolitic white rock. A few slivers of black shale and some crinoid joints noted	1,920
Brownish gray calcareous limestone with some rare white oolitic spherules	1,930

The limestone in the last three samples is probably an organic calcareous silt. In a certain light under the microscope the rock shows a fine text resembling that of a clastic rock with interstitial cement.

38. WELL NO. 21, ON FARM OF L. R. NEWLIN, MARTIN TOWNSHIP, CRAWFORD COUNTY.

Another well of the Ohio Oil Company is in the property of Mr. L. R. Newlin in the SW. ¼ SE. ¼ sec. 27, T. 6 N., R. 13 W., in Martin Township, Crawford County. Its elevation is 498 feet above sea level. The last 90 feet of the section are probably in the Pottsville. The coal at 500 feet is probably No. 6.

Description of samples from well on Newlin farm.

	Depth in feet. From.	To.
Drift	1	25
Dark limestone, brown limestone, fragments of coal and yellow sand	25	30
Dark limestone with sand	30	40
Gray sandstone with infiltrated calcite	40	45
Gray sandstone, some yellow limestone and siderite	45	50
Gray sandstone with some yellow limestone. Pyrite noted	50	60
Coarse gray micaceous sand with fragments of coal	60	65
Coarse gray micaceous sand	65	70
Coarse gray micaceous sandstone	70	75
Coal and some fire clay	75	80
Gray micaceous sand. A little calcareous substance in sand	80	110
Dark micaceous shale and sand	110	115
Gray micaceous shale and sand. A few fossil fragments	115	120
Limestone, fragmental, organic crinoid fragments and bryozoa noted	120	125
Light gray shale of fine texture	125	130
Limestone, in part fragmental, and some shale	130	135
Gray sandy shale, with some crinoidal limestone	135	140
Gray micaceous sandy shale, with some limestone	140	145
Gray micaceous shale	145	150
Gray micaceous sandstone and much dark clay-iron-stone	150	155
Gray micaceous shaly sandstone, with embedded shreds of vegetation	155	160
Gray micaceous shaly sandstone	160	165
Like the preceding	165	170
Fine grained, gray micaceous sandstone with interstitial calcite	170	175
Some black, fissile shale. Mostly a dark blotched organic breccia limestone, containing many crinoid stems, some small shells of Athyris and some crinoid spines	175	180
Like the preceding, with some sandstone and coal	180	185
Sandstone, limestone and shale	185	190
Micaceous sandstone, with some laminated sandy shale	190	195
Gray sandstone, quite coarse	195	200
Gray sandstone	200	205
Gray sandstone	205	210
Micaceous silty gray shale	210	215
Like the preceding	215	220
Like the preceding	220	225
Like the preceding	225	230
Like the preceding	230	235
Like the preceding	235	240

Description of samples from well on Newlin form—Continued.

	Depth in feet. From.	To.
Gray shale, and some dark shale	240	245
Bellerophone, Athyris, a cyathophyllid, two gastropods	245	250
Black shale and coal	250	255
Yellowish and gray concretionary siderite and limestone, with some fire clay and coal	255	260
Gray shale	260	265
Gray sandstone and some dark shale	265	270
Gray, micaceous sandstone	270	275
Laminated gray sandstone of fine texture	275	280
Gray shale and fire clay	280	285
Gray sandstone	285	290
White sandstone with siderite concretions	290	295
Laminated sandstone	295	300
Micaceous sandstone and dark shale	300	305
White, micaseous sandstone	305	310
Like the preceding	310	315
Like the preceding	315	320
Like the preceding	320	325
Like the preceding	325	330
Gray, sandy shale, micaceous	330	335
Like the preceding	335	340
Like the preceding	340	345
Gray, micaceous, sandy shale and some dark gray shale	345	350
Like the preceding with some clay ironstone	350	355
Mostly coal, some shale and some fragments of concretionary limestone	355	360
Gray sandstone with siderite	360	365
Gray sandy shale, micaceous	365	370
Like the preceding	370	375
Gray sandstone, with some white limestone	375	380
Gray sandstone, with interstitial calcareous material and some pure white limestone	380	385
Greenish gray sandstone	385	390
Gray sandstone with many concretionary spherules about .5 mm. in diameter	390	395
Gray sandstone	395	400
Dark gray sandy shale, stiff	400	405
Dark gray micaceous shale	405	410
Dark gray shale	410	415
Dark shale and limestone with pyrite, calcite and an *Estheria* (?)	415	420
Coal with some limestone fragments and shale	420	425
Coal and fire clay	425	430
Gray sandstone, with some yellow fragments of concretionary material	430	435
Gray sandstone	435	440
White sandstone	440	445
Yellowish white sandstone	445	450
Dark shale	450	455
Black shale and coal	455	460
Gray sandstone, micaceous	460	465
Gray limestone and some large quartz grains	465	470
Gray sandy shale, micaceous	470	475
Sandstone and some limestone	475	480
Shaly sandstone, with some siderite concretions	480	485
Black and dark micaceous shale	485	490
Black dolomitic limestone, with calcite, *Rhombopora lepidedendroides* and crinoid stems	490	495
Black limestone, with crinoid stems, and coal	495	500
Gray micaceous sandstone, with some intersticial calcareous material,	500	505
Like the preceding	505	510
Gray sandstone and a dirty yellow dolomitic limestone concretionary (?)	510	515
Gray sandy or silty shale, with yellow concretionary limestone	515	520
Gray silty shale, with embedded carbonaceous shreds	520	525
Gray silty shale with thin layers of shiny coal of silky lustre. Coal layer in one fragment adhering to the shale	525	530
Gray shale of fine texture	530	535
Dark shale of fine texture	535	540
Like the preceding	540	545
Like the preceding	545	550
Like the preceding	550	555
Black shale and coal, mostly impure	555	560
White sandstone of fine texture	560	565
Light gray shale, with many small spherical siderite concretions	565	570
Gray shale, with much siderite, in fragments and in minute spherical concretions. Some bright red fragments noted	570	575
Shaly sandstone and sandy shale, gray, with siderite as in preceding sample	575	580
Sandy shale, gray, with siderite fragments	580	585
Gray sandstone, some shale and siderite	585	590
Shaly gray sandstone or sandy shale	590	595

Description of samples from well on Newlin farm—Concluded.

	Depth in feet. From.	To.
Sandstone, black shale, and "clod" with some coal and siderite concretions	595	600
Like the preceding	600	605
Shale and shaly sandstone, with fragments of siderite concretions and coal	605	610
Greenish fire clay and shale	610	615
Shaly gray sandstone	615	620
Black "miner's" slate, with siderite concretions	620	625
Black "miner's" slate, with sandstone and gray shale	625	630
Gray sandy shale	630	635
Dark gray, sandy shale, micaceous	635	640
Dark gray, sandy shale, micaceous	640	645
Gray, laminated shaly sandstone	645	650
Dark gray, sandy shale	650	655
Black, stiff shale, almost "miner's" slate	655	660
Like the preceding	660	665
Black, stiff shale and impure coal	665	670
Black shale and black, concretionary limestone with fossils	670	675
Gray sand and gray sandy shale, with some coal	675	680
Coal, with very bright (black) lustre, and fire clay	680	685
Coal, of bright lustre and brownish earthy streak, and some fire clay	685	690
Gray, gritty fire clay and dark shale	690	695
Gray shale	695	705
Gray shale and some siderite	705	710
Dark limestone, some dark shale and pyrite	710	720
Dark shale, some coal, and a little dark limestone	725	730
Dark shale, some dark limestone, and spherulitic siderite	720	725
Dark shale, some coal, and spherulitic siderite	730	735
Gray micaceous shale, and bits of yellow limestone	735	740
Gray micaceous shale, and fragments of siderite	740	745
Dark micaceous shale, some siderite, bits of coal and limestone	745	750
Gray micaceous shale and siderite	750	755
Gray micaceous shale, some fire clay, coal and pyrite	755	760
Coarse gray micaceous sandstone, and a little shale	760	770
Black shale and some coarse sandstone	770	7
Coal and fire clay, and some gray shale	775	780
Coal and fire clay, and some gray fire clay, with pyrite	780	785
Black shale, bits of yellow limestone, spines of brachiopods and spherulitic siderite	785	790
White sandstone and black shale, some yellow limestone, and spherulitic siderite	790	795
Dark shale, some little sandstone, siderite and limestone	795	800
Black shale and some siderite	800	810
Black shale	810	820
Gray micaceous shale and some sandstone	820	825
Dark and white limestone, some sandstone with infiltered calcite, gray micaceous shale, pyrite and some crinoid joints	825	830
Dark and white limestone, with crinoid stems and pieces of shells, and pyrite	830	835
Gray micaceous sandstone, and some dark and some white calcite	835	840
Black, micaceous shale, some sandstone and white limestone	840	845
Black, micaceous shale	845	850
Black, micaceous shale, some white sand and siderite	850	860
Gray sandstone and dark shale	860	865
Gray sandstone, some dark shale and siderite	865	870
Coarse gray sandstone and a little shale	870	875
Gray, micaceous sand	875	885
Gray sand and some dark shale	885	890
Gray sand, white limestone, little shale and pyrite	890	895
Gray sandstone, bits of limestone, shale, siderite	895	905
Gray, micaceous sand	905	940
Gray, micaceous sand, and some dark shale	940	945
Dark shale and gray sandstone	945	950
Dark, sandy, micaceous shale	950	955

39. WELL NO. 9, ON C. T. COCHRAN'S FARM, MONTGOMERY TOWNSHIP, CRAWFORD COUNTY.

Well No. 9, on the property of Mr. Cochran is also operated by the Ohio Oil Company. It is located at the NE. cor. SW. ¼ sec. 21, T. 5 N., R. 11 W., in Montgomery Township, Crawford County. Its elevation is unknown. Its entire section is believed to be in the Pennsyl-

vanian. *Fusulina* was found in the sample from 556 to 562 feet. Coal No. 6 lay below.

Description of samples from well on Cochran's farm.

	Depth in feet. From.	To.
Yellow sandstone, disintegrated	1	6
Yellow sandstone	6	12
Yellow sandstone with infiltrated calcite and oxidized siderite concretions	12	19
Yellow sandstone and concretions	19	24
Yellow sandstone, siderite concretions and some black crinoidal limestone	24	38
Yellow sand, dark calcareous limestone and siderite concretions	38	45
Brown coarse sandstone, dark limestone, with siderite concretions—one spherical, half inch in diameter	45	51
Gray sandstone with infiltrated calcite and siderite concretions	51	58
Gray sandstone with infiltrated calcite, and siderite concretions	58	64
Dark gray shale	64	78
Black shale	78	85
Gray micaceous sandy shale	85	91
Gray micaceous shaly sandstone	91	98
Gray shale	98	104
Gray shale, siderite, a few fragments of coal	104	111
Gray shale, siderite	111	117
Black shale	117	124
Gray sandy shale, fragments of coal	124	130
Gray micaceous shale	130	137
Fine gray, laminated, sandstone, black shale	137	143
Gray sandstone, black shale, brown limestone	143	150
Gray sandstone, brown limestone, black shale	150	156
Brown limestone, gray shale, gray sandstone	156	163
Gray shale, gray sandstone, fragments of siderite concretions	163	170
Gray laminated micaceous sandstone, siderite concretions	170	176
Coarse gray micaceous sandstone	176	223
Coarse gray micaceous sandstone, a few pieces of coal, pyrite and siderite	223	231
Coarse gray micaceous sandstone, with infiltrated calcite	231	237
Coarse gray micaceous sandstone, with infiltrated calcite, and fragments of black shale	237	244
Coarse gray micaceous sandstone, with infiltrated calcite, and fragments of impure coal	244	250
Gray shaly sandstone, concretions of brown limestone	250	257
Gray sandy shale	257	270
Greenish gray shale with infiltrated calcite	270	276
Gray micaceous sandstone	276	296
Coarse gray sand	296	309
Coarse gray sand with carbonaceous laminae	309	315
Coarse gray sand	315	328
Coal and fire clay, a few fragments of mottled limestone	328	335
Gray sandstone	335	341
Gray sandstone, limestone	341	348
Gray calcareous limestone	348	361
Greenish gray sandstone and gray calcareous limestone	361	367
Gray shale and calcareous limestone	367	374
Gray micaceous shale, with some gray calcareous limestone	374	380
Gray micaceous sandstone and gray shale	380	387
Gray shale	387	413
Gray sandy shale	413	419
Gray sandy micaceous shale	419	432
Coarse gray sandstone with carbonaceous laminae	432	439
Gray shale	439	445
Gray shale, micaceous	445	452
Coal, siderite concretions, pyrite crystals and a few white gypsum crystals	452	465
Gray micaceous shaly sandstone	465	471
Gray micaceous sandstone with infiltrated calcite	471	478
Gray shale, gray sandstone	478	497
Coal, gray shale, dark limestone, pyrite, and a few crinoid stems noted	497	504
Coal, pyrite, and a few crinoid stems noted	504	510
Coarse gray micaceous sandstone with infiltrated calcite	510	523
Coarse gray micaceous sand	523	530
Gray micaceous sandy shale	530	536
Gray shale, fragments of coal and pyrite	536	543
Black shale, some limestone, and numerous crinoid stems noted	543	549
Gray micaceous sandstone	549	556
Dark limestone with *Chonetes punctatus, Rhombopora lepidodendroides* and showing intensely green specks. *Fusulina* present	556	562
Coal, some limestone	562	569
Gray sandy shale, some pyrite	569	575
Gray sandy micaceous shale	575	582

Description of samples from well on Cochran's farm—Concluded.

	Depth in feet. From.	To.
Coarse gray sand with fragments of black shale	582	588
Gray sandstone with some limestone	588	595
Gray shaly sandstone	595	608
Gray shale and sandstone	608	621
Gray shale	621	666
Black and gray shale	666	673
Black shale	673	679
Brown limestone, greenish red dolomitic shaly limestone and very dark gray shale	679	686
Gray limestone, some gray shale and fragments of brown limestone; two small gasteropods	686	692
Coal, some gray and brown limestone	692	699
Gray sandy micaceous shale	699	705
Gray shale	705	712
Gray sandy micaceous shale	712	718
Gray sandy micaceous shale	718	725
Gray shale	725	731
Black shale	731	737
Black and gray shale	737	743
Black stiff shale	743	750
Coal, some gray shale	750	756
Coarse gray sandstone with infiltrated calcite, fragments of coal and gray shale	756	763
Gray sandy micaceous shale	763	769
Black shale, coarse gray sandstone, fragments of coal	769	775
Gray sandy shale, black shale	775	781
Gray micaceous shale, gray sandstone with infiltrated lime	781	787
Gray shale and gray micaceous shale	787	793
Gray shale	793	806
Black stiff shale	806	813
Coal, fire clay	813	820
Gray shale	820	834
Gray micaceous sand and shale	834	840
Yellow micaceous sand	840	846
Gray shale	846	862
Gray shale with fragments of gray sandstone	862	873
Gray and black shale	873	884
Black shale	884	895
Gray shale	895	906
Gray sandstone with shreds of vegetation and a few fragments of coal	906	912
Gray sandstone with shreds of vegetation	912	923
Gray micaceous sandstone	923	928
White micaceous sand with fragments of shale	928	934
Gray laminated sandstone	934	940
Gray laminated sandstone, brown sandstone	940	952
Brown sandstone (Note on sack "Oil 952 to 973"), gray sandstone	952	958
Brown sandstone, some gray sandstone	958	964
Brown sandstone, some gray sandstone, pyrite	964	970
Brown sandstone, some gray sand	970	975

40. WELL NO. 4, ON FARM OF S. G. M'LEAVE, BRIDGEPORT TOWNSHIP, LAWRENCE COUNTY.

The well for the Ohio Oil Company on the farm of Mr. McLeave is at the center of sec. 31, T. 4 N., R. 12 W., Bridgeport Township, Lawrence County. Its curb is at an elevation of 520 feet above sea level. Its section to a depth of 1,300 feet is through Pennsylvanian strata, with the Pottsville from 900 feet to 1,300 feet. Below 1,300 feet the section is in the Mississippian beds. The coal from 505 feet to 510 feet is No. 6.

Description of samples from McLeave well.

	Depth in feet. From.	To.
Loess	1	5
Like the preceding	5	10
Like the preceding	10	15
Yellow limestone and coal, some calcite, and numerous crinoid stems	15	20
Coal, yellow sandstone,some gray sandstone and crinoidal limestone	20	25
Coal, yellow sandstone, some crinoidal limestone and a few pieces of calcite and red marl. Numerous crinoid stems	25	30

Description of samples from McLeave well—Continued.

	Depth in feet. From.	To.
Gray micaceous sandstone with infiltrated calcite, some yellow sandstone, bits of coal and calcite	30	35
Coal, some yellow and white sandstone, some pieces of crinoidal limestone	35	40
Gray micaceous sandstone, some dark shale and fire clay	40	45
Coal, some crinoidal limestone, a little red material. A small *Athyris* shell noted, also a piece of crinoid calyx (?)	45	50
White micaceous sandstone, a few pieces of fire clay and coal	50	55
White micaceous sandstone	55	60
White micaceous sandstone, a few pieces of dark shale	60	65
Gray micaceous laminated sandstone, some fragments of yellow limestone, some coal	65	70
Gray micaceous sandstone, a few fragments of yellow limestone and coal	70	75
Yellow sandstone, crinoidal limestone, some black shale and pieces of gypsum. Two *Ambocoelia planoconvexa* and a crinoid stem noted	75	80
Black shale, some dark limestone, and a few pieces of sandstone. A crinoid stem noted	80	85
Gray limestone and coal, with some sandstone and shale	85	90
Gray micaceous shale	90	95
Yellow limestone, some gray sandstone, and bits of siderite	95	100
Yellow limestone and gray sandstone, some siderite concretions and shale	100	105
Gray shale and fire clay	105	110
Dark shale, some siderite concretions, and bits of white limestone	110	115
Coal, some black shale, gray sandstone, a few bits of calcite and pyrite	115	120
Gray micaceous sandy shale, some dark shale and coal, some pieces of yellow limestone and fire clay	120	125
Dark shale, some coal, a few pieces of limestone	125	130
Dark shale, some red oxidized material, and siderite concretions	130	135
Coal, some gray micaceous shale, and gray sandstone	135	140
Gray micaceous shale, some coal and fire clay	140	145
Gray micaceous shale and sandstone, some siderite concretions, a few bits of white limestone	145	150
Gray micaceous shale and a few bits of siderite concretions	150	155
Siderite, concretionary, and some gray micaceous shale	155	160
Coal and gray sandstone, some concretionary siderite, some bits of limestone and pyrite. A crinoid stem noted	160	165
White sandstone with infiltrated calcite	165	170
Like the preceding	170	175
Like the preceding	175	180
Fine gray sand with infiltrated calcite	180	185
Fine gray micaceous sand with infiltrated calcite, some gray shale	185	190
Fine gray sand with infiltrated lime	190	195
Like the preceding	195	200
Fine gray micaceous sand with some infiltrated calcite	200	205
Like the preceding	205	210
White micaceous sand	210	215
White micaceous sand	215	220
Like the preceding	220	225
Sand with infiltrated calcite and some coal	225	230
Coal, some white limestone and black shale, some siderite	230	235
Gray micaceous shaly sandstone, some bits of coal, pyrite, and siderite	235	240
Yellow sand with infiltrated calcite; the smaller grains float on water	240	245
Gray micaceous sandstone, some small spherules of siderite concretions, a few pieces of pyrite and white limestone	245	250
Gray sandstone, some siderite concretions (spherules), some dark shale, and bits of white limestone	250	255
Dark sandy micaceous shale, some gray sandstone, and siderite	255	260
Like the preceding	260	265
White sandstone	265	270
White micaceous shaly sandstone, a few pieces of gray shale	270	275
White micaceous sandstone	275	280
Gray micaceous sandstone, some pieces of laminated sandstone	280	285
Like the preceding	285	290
Gray micaceous sand	290	295
Gray micaceous sandstone, some pieces laminated	295	300
Like the preceding	300	310
White micaceous sand	310	320
White limestone, indistinctly fragmental, a little sand, and some gray shale	320	325
White limestone like the above, a little dark shale. A crinoid stem noted	325	330
White, indistinctly fragmental limestone. Some bits of pyrite, and a crinoid stem noted	330	335
Greenish compact limestone, and micaceous sandstone, with some shale	335	340
Gray shale, some sandstone	340	345
Gray micaceous sandy shale	345	350
Gray micaceous shale, some yellow limestone, one piece containing woody fibre (?)	350	355

Description of samples from McLeave well—Continued.

	Depth in feet. From.	To.
Gray sandy shale, some yellow limestone, and a few siderite concretions	355	360
Gray shale, micaceous sandy shale, and some yellow limestone	360	365
Gray sandstone, some laminated yellow sandstone, some yellow limestone, fragments of siderite	365	370
Gray shale and sandstone, some siderite concretions	370	375
Gray sandy shale, some siderite concretions. Carbonaceous shreds noted in shale	375	380
Siderite concretions, some sandy shale	380	385
Gray sandy shale, some concretionary siderite and bits of gray sandstone	385	390
Gray sandstone and sandy shale. A few pieces of black carbonaceous shale, coal, some sandstone with infiltrated calcite, and some crinoid stems. *Retzia punctulifera* noted	390	395
Gray sandstone, dark shale, some white limestone, concretionary siderite. A crinoid stem and *Athyris* noted. A little coal present	395	400
Gray shale and some sandstone, concretionary siderite, bits of pyrite, and a few pieces of sandstone with infiltrated calcite	400	405
Gray sandy shale, and some concretionary siderite	405	410
White breciated limestone, with cracks filled with yellow calcite, some yellow limestone, some siderite, a little gray shale, and sandstone, with bits of pyrite	410	415
White limestone, cracks filled with yellow calcite, some concretionary siderite	415	420
White limestone, having cracks filled with yellow calcite; some yellow limestone, some gray soft shale, and a few bits of coal	420	430
White and yellow limestone, cracks filled with calcite, some gray sandstone and a few pieces of black shale	430	435
Gray shale and concretionary siderite	435	450
Dark gray shale and siderite concretions	450	465
Dark shale and some siderite concretions	465	475
Gray sandy shale, some gray sandstone, siderite, and a few fragments of yellow limestone	475	480
Gray sandy shale, some pieces of which have layers of siderite. Yellow limestone and bits of pyrite	480	485
Gray micaceous shale, some gray sandstone, few small fragments of yellow limestone	485	490
Gray micaceous shale	490	495
Dark shale, some siderite concretions, a few pieces of white limestone and pyrite	495	500
Dark shale, some coal and concretionary siderite, and a few pieces of dark limestone. A crinoid stem noted, also some oolitic black concretionary material	500	505
Dark shale and some siderite, a few bits of white limestone, coal, and pyrite. Crinoid stem and closely tuberculated crinoid pinnule noted, also a spiral *Ammodiscus*, *Rhombopora lepidodendroides*, and black shale with fucoidal traversions	505	510
Dark shale, some siderite, white limestone fragments, and bits of coal and pyrite. Crinoid stems and a small *Syntrielasma hemiplicata* noted	510	515
Gray micaceous shale, some gray sandstone and yellow limestone	515	520
Gray micaceous shale, some sandstone, some pieces of yellow limestone	520	525
Gray micaceous shale	525	530
Gray micaceous shale and some sandstone	530	535
Gray micaceous shale and some siderite	535	540
Gray micaceous shale, some siderite, and a few bits of yellow limestone	540	545
Gray sandy shale, some yellow sandstone, bits of yellow limestone and pyrite	545	550
Black shale with streaks of pyrite, some siderite concretions, and bits of white limestone	550	555
Black shale, some siderite concretions, and white limestone. Crinoid stem noted	555	560
Black shale and a few siderite concretions	560	565
Yellow concretionary limestone and black shale. Some siderite. More shale than limestone	565	570
White and yellow concretionary limestone, some dark shale and sandstone, bits of pure calcite, and pyrite. More shale than limestone	570	575
Black carbonaceous shale and coal, some white limestone and siderite, and some bits of pyrite	575	580
Dark shale, some pieces of yellow limestone	580	595
Dark shale, some pieces of yellow limestone and white sandstone. A few pieces of calcite	595	600
Dark gray micaceous shale, some yellow limestone with layers of calcite, and some sandy shale	600	605
Gray sandy shale, some yellow limestone, bits of white sandstone and pyrite	605	610
Gray sandy shale, some pieces of dark limestone, and bits of pyrite	610	615
Dark sandy shale, some pieces of pyrite	615	620

Description of samples from McLeave well—Continued.

	Depth in feet. From.	To.
Dark gray micaceous shale, some pieces of yellow limestone, and siderite concretions	620	625
Dark gray shale, some pieces of yellow limestone and siderite. A crinoid stem noted	625	630
Gray shale	630	635
Gray shale, few siderite concretions, and crinoid stems	635	640
Gray sandy shale, some yellow limestone, and concretionary carbonate of iron	640	645
Gray shale, some coal, and siderite	645	650
Soft gray shale, some yellow limestone, and siderite	650	655
White limestone, some "clod" and some sandstone	655	660
Black "clod," some yellow limestone, and soft gray shale	660	665
"Clod" with little white limestone and crinoid stems	665	675
"Clod," crinoid stems, an Edmondia (?), with some white limestone	675	680
Gray shale, yellow limestone, and some "clod"	680	685
Yellow limestone and gray sandstone, some concretionary siderite and gray shale	685	690
Soft gray shale, yellow limestone, and some sandstone	690	695
Gray micaceous sandy shale, yellow and white limestone, some "clod," and some pyrite	695	700
Gray micaceous shale, some siderite, some white limestone, pieces of calcite, with some sandstone	700	705
Gray, sandy shale, some black shale, and siderite with a few pieces of coal	705	710
Gray sandy shale, some coal, and siderite	710	715
Gray sandstone and some black carbonaceous shale	715	720
Coal and some fire clay	720	725
Black shale	725	735
Hard black shale	735	740
Black shale, a little white sandstone	740	745
Gray sandstone, some black pyritiferous shale, and yellow limestone	745	750
Gray sandstone, bits of yellow limestone	750	755
Gray micaceous sandstone, some pieces laminated, and bits of yellow limestone	755	760
Gray shale and sandstone, some imprints of leaves in shale	760	765
Dark shale, some sandstone, laminated and micaceous, bits of yellow limestone	765	770
Gray micaceous sandstone and dark shale, some yellow limestone	770	780
Gray micaceous sandstone, some dark shale, few bits of limestone	780	785
Gray micaceous sandstone and some dark shale	785	790
Dark gray micaceous shale, bits of yellow limestone and siderite	790	795
Black micaceous shale	795	800
Gray shale and some black micaceous shale	800	805
Gray shale with some imprints of vegetation	805	810
Dark micaceous shale and some pieces of yellow limestone	810	815
Dark shale, some fragments of yellow limestone	815	820
Gray micaceous sandstone, some shale, bits of yellow limestone (small)	820	825
Gray micaceous sandstone, little shale and limestone	825	835
Gray sandstone, with concretionary yellow limestone	835	840
Gray sandstone, some yellow limestone, and white limestone, with some pieces of dark limestone	840	845
Gray micaceous sandstone, some gray shale, and a few pieces of yellow limestone	845	850
Dark gray shale, some gray sandstone, few pieces of yellow limestone and yellow calcite. Crinoid stems and a piece of shell noted	850	855
Black shale and a little white limestone. Crinoid stems and a piece of brachiopod shell noted	855	860
Black shale and a little yellow limestone. Piece of shell and crinoid stem noted	860	865
Black shale, few pieces of yellow and white limestone	865	870
Black shale, some concretionary siderite and bits of yellow limestone	870	875
Black shale and some gray shale	875	880
Black shale, some siderite, and gray sandstone	880	885
Gray micaceous sandstone and few pieces of shale	885	890
Gray sandstone, few pieces of yellow limestone and dark shale	890	895
Gray micaceous shale, some sandstone	895	900
Gray micaceous shale	900	905
Gray micaceous shale and some dark shale	905	910
Dark and gray micaceous shale	910	915
Dark gray shale and a few pieces of white limestone	915	920
Dark gray shale, bits of limestone and pyrite	920	925
Black shale	925	930
Black shale and some fire clay, bits of sandstone	930	935
Gray sandstone and some dark sandy shale	935	940
Dark shale and sandstone, bits of yellow limestone	940	945
Dark sandy shale and sandstone	945	950
Dark shale, some sandy shale	950	955
Gray micaceous shaly sandstone	955	960
Gray micaceous sandy shale and sandstone	960	970
Gray micaceous shaly sandstone, some black shale	970	975

Description of samples from McLeave well—Continued.

	Depth in feet. From.	To.
Gray micaceous sandy shale, bits of yellow limestone	975	980
White micaceous sand, little dark shale	980	985
White micaceous sand, some dark laminated shale	985	990
Gray sandstone and some dark micaceous shale. Sandstone with infiltered calcite, some pieces of laminated sandstone	990	995
White micaceous sand, some dark shale	995	1,000
White micaceous sand, little dark shale	1,000	1,005
Gray micaceous sand	1,005	1,010
Gray micaceous sandstone, some dark shale	1,010	1,015
Gray micaceous sandstone	1,015	1,025
Gray shale	1,025	1,035
Dark gray shale	1,035	1,040
White micaceous sand, grains mostly from .125 mm. to .25 mm. in diameter	1,040	1,045
White micaceous sand	1,045	1,065
White micaceous sand with a little infiltered calcite	1,065	1,070
White micaceous sand with some infiltered lime, a little dark shale	1,070	1,080
Gray micaceous sandstone and shale	1,080	1,085
White micaceous sand with some infiltered calcite	1,085	1,090
Yellow micaceous sand	1,090	1,125
Yellow sand	1,125	1,130
Yellow sand, showing secondary enlargement of grains	1,130	1,135
Yellow sand	1,135	1,140
Yellow sand and some dark shale	1,140	1,145
Gray sand with some secondary enlargement of crystals	1,145	1,150
White sand, very fine	1,150	1,155
White sand	1,155	1,160
Fine white sand	1,160	1,165
White sand and some gray shale	1,165	1,170
Fine white sand	1,170	1,175
Fine white sand with some infiltrated calcite	1,175	1,180
Yellow sand	1,180	1,190
Yellowish sand with infiltrated calcite	1,190	1,210
White sand, grains mostly from .125 mm. to .25 mm. in diameter	1,210	1,215
Fine white sand	1,215	1,230
White sand, some grains show secondary enlargement	1,230	1,235
White sand	1,235	1,250
White, fine, sand	1,250	1,280
Yellowish sand	1,280	1,290
Yellow sand and some white limestone	1,290	1,300
White limestone and sand	1,300	1,305
Like the preceding but with more calcite	1,305	1,310
Greenish shale with some flakes of mica, some white and dark limestone. Some imprints of leaves	1,310	1,315
Greenish shale or a fire clay, some limestone, and bits of pyrite. Imprints of vegetation	1,315	1,320
Gray sandstone, some pieces of pyrite, and greenish shale like in the preceding	1,320	1,325
Gray sandstone with some flakes of mica	1,325	1,330
A tangled organic oolitic limestone breccia and some sandstone	1,330	1,335
A tangle of organic oolitic limestone, effervescence brisk. Some greenish shale and sand, bits of pyrite	1,335	1,345
A tangled organic oolitic limestone, some pieces of green and red shale	1,345	1,350
Oolitic limestone, some dark shale, bits of green and red shale and two pieces of chert	1,350	1,355
A tangled organic oolitic limestone breccia, some black greenish and brown shale	1,355	1,370
Black shale and limestone, like that of the preceding sample	1,370	1,375
Black shale and some oolitic limestone, effervescence brisk	1,375	1,380
Black and green shale, white limestone	1,380	1,390
Black shale and some sandstone	1,390	1,395
Black shale and little sandstone	1,395	1,400
Greenish and red shale, some limestone, effervescence brisk. Bits of chert and pyrite	1,400	1,405
Dark shale and some reddish colored limestone, effervescing briskly	1,405	1,410
Dark and reddish brown shale, some gray limestone	1,410	1,415
Dark shale and some gray limestone, a little red shale	1,415	1,420
Black shale and a little limestone	1,420	1,425
Black marly shale and some white limestone. Bits of pyrite and red shale	1,425	1,435
White limestone, some black marly shale and red shale; numerous crinoid stems	1,435	1,440
Black shale, some marly shale and white limestone, crinoid stems and pieces of shells	1,440	1,445
White limestone and dark shale	1,445	1,450
White limestone and dark shale; some yellow sandstone	1,450	1,455
Grayish yellow sandstone with infiltered calcite, some dark shale and white limestone	1,455	1,470
Gray sandstone, some black shale	1,470	1,475

Description of samples from McLeave well—Concluded.

	Depth in feet. From.	To.
Red shale, some greenish sandstone with infiltered calcite, and little gray sandstone	1,475	1,480
Dark sandy calcareous shale, some white limestone and red shale	1,480	1,485
Coarse gray sand and some black shale	1,485	1,490
Coarse gray sand	1,490	1,500
White sandstone with infiltered calcite and some dark shale	1,500	1,515
Gray sandstone and a little dark shale	1,515	1,535
Black shale	1,535	1,550
Black shale, some yellowish sandstone with infiltered calcite	1,550	1,560
Black shale and white limestone. A few fragments of shells	1,560	1,565
Black shale and white sandstone, and little limestone	1,565	1,585
Black shale, white limestone, effervescence brisk, and some sand	1,585	1,590
Black shale and some white fragmental limestone, a crinoid stem noted	1,590	1,595
Black shale	1,595	1,600
Black shale and little limestone	1,600	1,605
Black shale, some sandstone, and white limestone	1,605	1,610
Gray sand, white limestone, and a little dark shale	1,610	1,620
White limestone and dark shale	1,620	1,625
Black shale and little limestone	1,625	1,645
Black shale and some limestone. A crinoid stem noted	1,645	1,650
Black shale and some limestone	1,650	1,660
Black shale	1,660	1,665
Black and red shale, some white limestone	1,665	1,670
Black shale, some red shale and oolitic limestone, effervescing briskly	1,670	1,680
Greenish and reddish shale, some oolitic limestone	1,680	1,685
Greenish shale, some red shale and oolitic limestone	1,685	1,690
Oolitic limestone, a little sand and greenish shale	1,690	1,710
Oolitic limestone	1,710	1,740
Oolitic limestone, little greenish shale, and bits of pyrite	1,740	1,745

The writer's interpretation of the above section is as below:

	Feet below surface.
Coal No. 6	505- 510
Pennsylvanian	0- 900
Pottsville	900-1,300
Mississippian	1,300-1,745

41. WELL NO. 2, ON FARM OF W. B. GRAY, BRIDGEPORT TOWNSHIP, LAWRENCE COUNTY.

The Ohio Oil Company's well No. 2, on the farm of W. B. Gray is in the SW. ¼ sec. 7, T. 3 N., R. 12 W., Bridgeport Township, Lawrence County. Its elevation above sea level is 495 feet. The set of samples from this well is very full. From a careful study of these it is evident that the top of the Chester is at the depth of 450 feet.

Description of samples from Gray well.

	Depth in feet. From.	To.
Yellow micaceous sandstone, with some quartz pebbles	1	5
Like the preceding	5	10
White micaceous sandstone with shreds of carbonaceous matter	10	15
Like the preceding	15	20
Like the preceding	20	25
Like the preceding	25	30
White micaceous sandstone, with some fragments of siderite and pyrite	30	35
Gray sandstone, with shreds of vegetation	35	40
Gray sandy shale	40	45
Black shale and some gray sandstone	45	50
Black micaceous shale	50	55
"Clod," with numerous crinoid stems	55	60
Black shale and "clod"	60	65
Coal and "clod"	65	70
Coal, fragments of siderite concretions, limestone and some gray sandstone	70	75
Gray sandy shale	75	80

Description of samples from Gray well—Continued.

	Depth in feet. From.	To.
Black shale, "clod," some coal and some pure calcite	80	85
Like the preceding	85	90
Dark micaceous shale and coal with calcite	90	95
Dark gray micaceous shale	95	100
Black shale, with a few crinoid joints	100	105
Black shale	105	110
Black shale with some limestone	110	115
Black shale	115	120
Hard black shale	120	125
Like the preceding	125	130
Black shale	130	135
Black micaceous shale	135	140
Gray micaceous sand, with some black shale	140	145
Gray micaceous sandstone, with infiltrated calcite, and shreds of carbonaceous matter	145	150
Like the preceding	150	155
Gray micaceous sand	155	160
Like the preceding	160	165
Gray micaceous sandstone of fine texture	165	170
Gray micaceous sandstone	170	175
Like the preceding	175	180
Like the preceding	180	185
Like the preceding	185	190
Like the preceding	190	195
Like the preceding	195	200
Like the preceding	200	205
Gray sandstone, some black shale, and a little limestone	205	210
Black shale and gray sandstone, with a little limestone	210	215
Dull bluish green shale, with some yellowish limestone (from concretions?)	215	220
Like the preceding, with fossils in concretionary limestone	220	225
Shale, light green, gray, smooth	225	230
Like the preceding	230	235
Like the preceding	235	240
Greenish gray micaceous shale	240	245
Light greenish gray shale, smooth	245	250
Light greenish gray micaceous shale	250	255
Like the preceding	255	260
Like the preceding	260	265
Gray micaceous sandy shale	265	270
Gray, rather coarse sandstone with occasional red, pink, green and black grains	270	275
Like the preceding, all crushed	275	280
Fire clay, fragments of concretions, sandstone, and some shreds of carbonaceous material	280	285
Fire clay	285	290
Greenish blue shale, with concretionary yellow limestone	290	295
Black shale, with some bits of coal	295	300
Gray micaceous sandstone with infiltrated calcite. Some black shale and coal	300	305
Gray sandstone, in part laminated, with small siderite concretions	305	310
Gray micaceous sandstone with small siderite concretions	310	315
Gray sandstone with some black shale	315	320
Dirty white limestone, and some sand. Pyrite, crinoid joints, and spine of a *Productus* noted	320	325
Limestone and some shale	325	330
Limestone of light color, some gray shale and pyrite. Limestone seems to be concretionary	330	335
Gray shale and black shale, with yellow concretiomnary limestone	335	340
Gray shale, with some concretionary limestone	340	345
Like the preceding	345	350
Dark gray shale and some yellow concretionary limestone	350	355
Dark gray shale, with some pyrite	355	360
Dark gray shale, some white limestone and pyrite	360	365
Dark gray shale	365	370
Dark shale	370	375
Dark shale	375	380
Dark shale, with some fragments of siderite concretions	380	385
Like the preceding	385	390
Sandstone, shale and coal	390	395
Shale, with some sandstone and coal	395	400
Greenish gray shale	400	405
Olive colored shale	405	410
Laminated sandy shale	410	415
Sandy gray shale	415	420
Shale, stony, olive colored	420	425
Gray shale	425	430
Dark shale, almost black	430	435
Gray shale	435	440
Gray shale	440	445
Gray shale	445	450

Description of samples from Gray well—Continued.

	Depth in feet. From.	To.
Gray shale	450	455
Gray shale	455	460
Gray shale, coal and concretionary fragments	460	465
Gray fire clay, coal and shale	465	470
Gray shale and gray concretionary limestone, impure, with iron carbonate and with pyrite	470	475
Limestone, concretionary and shale	475	480
Gray shaly fire clay and concretionary limestone, effervescing slowly	480	485
Gray concretionary siderite	485	490
Gray shale, with much concretionary, impure, limestone or siderite	490	495
Like the preceding. N. B.—Samples 475-515 are essentially alike. The material with the shale is a concretionary carbonate apparently of calcium and iron. It is yellow or gray, and it effervesces very slowly. Samples contain as much of the concretionary limestone as of the shale	495	500
Concretionary impure limestone and shale	500	505
Dark gray shale with much concretionary impure limestone and siderite. Fucoidal traversions on the shale	505	510
Like the preceding	510	515
Gray sandy shale and siderite	515	520
Gray micaceous shale, some coal and siderite	520	525
Gray micaceous shale, with some coal	525	530
Gray micaceous shale and some bits of coal	530	535
Gray sandstone, laminated and with minute spherules of siderite	535	540
Gray shale, with some sandy shale and some black shale	540	545
Dark stony shale	545	550
Dark micaceous shale, with some limestone. Crinoid stem noted	550	555
Dark gray shale	555	560
Dark micaceous shale and clod, with *Productus*	560	565
Gray shale	565	570
Very dark shale and "clod"	570	575
Black clay shale, with "clod"	575	580
Greenish gray, micaceous, sandy, shale	580	585
Like the preceding	585	590
Gray micaceous shale	590	595
Like the preceding	595	600
Like the preceding	600	605
Greenish gray clayey shale	605	610
Like the preceding	610	615
Black stony shale and some red clay shale	615	620
Very dark stony shale	620	625
Dark checky shale or fire clay	625	630
Dark gray micaceous shale	630	635
Dark shale or fire clay, with imprints of leaf	635	640
Dark hard shale, slightly micaceous	640	645
Gray shale, with some siderite	645	650
Gray shale	650	655
Gray shale and some gray sandstone	655	660
Hard gray shale, with a few pieces of sandstone	660	665
Hard gray shale, with a few pieces of siderite	665	670
Dark and hard shale	670	675
Dark, hard shale	675	680
Like the preceding	680	685
Coal and dark shale, with some siderite and pyrite	685	690
Coal, with some shale and some siderite	690	695
Dark shale and some siderite, coal, and pyrite; a fragment of shell noted	695	700
Gray shale and coal, with concretions of siderite; and black shale, with leaf imprints, calcareous	700	705
Calcareous gray shale, fire clay and coal	705	710
Gray shale and fire clay, calcareous	710	715
Like the preceding, with pyritized wood	715	720
Gray clay shale, fine in texture	720	725
Black shale, sandstone, and coal	725	730
Gray sandstone and dark gray sandy shale	730	735
Like the preceding	735	740
Gray sandstone, and shale	740	745
Gray sandy shale	745	750
Sandstone and gray shale	750	755
Black miner's slate	755	760
Dark shale, carrying much pyrite	760	765
Gray shale, impregnated with small pyrite crystals	765	770
Gray shaly, sandstone, and black shale	770	775
Coal, sandstone and some yellow limestone, apparently from a solid stratum	775	780
Gray micaceous and sandy shale, some red clay shale	780	785
Gray shale, coaly shale, and shaly coal, with gray limestone and fragments of concretionary siderite	785	790
Gray clay shale, with some concretionary fragments	790	795
Gray shale, some black shale and siderite concretions	795	800
Gray shale, some black carbonaceous shale and some fire clay	800	805

Description of samples from Gray well—Continued.

	Depth in feet. From.	To.
Gray shale, some black coaly shale, a few bits of white limestone and minute concretionary spherules of siderite	805	810
Gray shale containing many minute spherules of siderite and some white limestone	810	815
Dark shale and fire clay	815	820
Like the preceding	820	825
Like the preceding	825	830
Dark shale with some imprints of vegetation	830	835
Dark shale and some sandstone, with some minute spherules of siderite	835	840
Black shale and gray shale, with some sandstone, some minute spherules of siderite, and a few bits of limestone	840	845
Black shale, some sandstone and some pieces of siderite	845	850
Gray micaceous shale	850	855
Black hard shale, with pyrite, shell of *Retzia* (?), some sponge spicules, and a few bits of white limestone	855	860
Black stony shale, with pyrite	860	865
Black shale, with pyrite and pieces of siderite	865	870
Like the preceding	870	875
Black shale and white fine grained sandstone, laminated, with a few small pieces of very white limestone	875	880
Gray laminated sandstone and black shale	880	885
Like the preceding	885	890
Black shale and laminated sandstone, with some grayish soft material and a few bits of white limestone	890	895
Coal, with some gray limestone	895	900
Gray sandy shale and fragments of concretionary siderite, with some coal	900	905
Black shale and gray shale, with some fragments of yellow limestone and concretionary material	905	910
Dark gray shale, with a little limestone, and some green, serpentine-like shale	910	915
Dark gray shale and greenish shale with red blotches, and a few fragments of limestone	915	920
Dark gray shale and gray sandy shale	920	925
Gray sandy shale, with minute crystals of pyrite	925	930
Dark gray shale and gray sandstone, with shreds of vegetation	930	935
Dark gray shale and sandstone	935	940
Gray shaly sandstone and sandy shale	940	945
Dark gray sandy shale, pyritiferous	945	950
Dark gray sandy shale	950	955
Gray clay shale	955	960
Gray shale and limestone. The limestone is white, and consists of rounded fragments, which are invested with an oolitic incrustation	960	965
Dark and stony thin-splitting shale and light sandstone	965	970
White and gray sandstone and dark gray shale. Sandstone occasionally with interstitial pyrite	970	975
Dark gray shale and white sandstone	975	980
Like the preceding	980	985
Dark greenish gray shale	985	990
Like the preceding	990	995
Like the preceding	995	1,000
Black shale of fine texture	1,000	1,005
Dark gray shale, with siderite partly in fragments, partly as spherules	1,005	1,010
Dark gray sandstone and dark shale	1,010	1,015
Dark shaly sandstone and black shale	1,015	1,020
Black shale with many fragments of siderite	1,020	1,025
Black shale	1,025	1,030
Black shale, and gray limestone, which contains a tangle of tubes of *Ammodiscus*	1,030	1,035
Dark gray and black shale, with limestone as above	1,035	1,040
White, gray sandstone and gray shale	1,040	1,045
White, slightly micaceous sandstone, and gray shale	1,045	1,050
Gray laminated shaly sandstone	1,050	1,055
Like the preceding	1,055	1,060
Gray sandstone	1,060	1,065
Gray laminated sandstone	1,065	1,070
Like the preceding	1,070	1,075
Like the preceding	1,075	1,080
Laminated gray sandstone and white sandstone	1,080	1,085
White sandstone	1,085	1,090
White sandstone	1,090	1,095
White sandstone	1,095	1,100
Yellow sandstone	1,100	1,105
Coarse white sand	1,105	1,110
Coarse white sand	1,110	1,115
Yellow sand	1,115	1,120
Yellow sand	1,120	1,125
Red sand	1,125	1,130
Reddish sand	1,130	1,135
White sand	1,135	1,140

Description of samples from Gray well—Continued.

	Depth in feet. From.	To.
White sand	1,140	1,145
White sand	1,145	1,150
White sand	1,150	1,155
White sand	1,155	1,160
White sand	1,160	1,165
Reddish sand	1,165	1,170
Pinkish sand	1,170	1,175
Gray sand	1,175	1,180
Gray sand	1,180	1,185
White sand	1,185	1,190
Grayish white sand	1,190	1,195
Black shale, with some few small fragments of red shale	1,195	1,200
Black shale and sand, with pyrite	1,200	1,205
Gray fire clay with shreds of vegetation	1,205	1,210
Black clay shale, gray sand	1,210	1,215
Black shale, gray fire clay-like shale, with shreds of vegetation and sandstone	1,215	1,220
Dark fire clay-like shale, with shreds of vegetation and some gray shale	1,220	1,225
Like the preceding	1,225	1,230
Fire clay, dark shale, and sandstone	1,230	1,235
Like the preceding	1,235	1,240
Gray shale and sand	1,240	1,245
Gray fire clay, and gray sandstone, with spherules of siderite	1,245	1,250
Black stony shale, with large fragments of pyrite and some gray compact siliceous rock	1,250	1,255
Like the preceding	1,255	1,260
Black shreds showing shreds of vegetation and some gray rock	1,260	1,270
Like the preceding	1,270	1,275
Like the preceding	1,275	1,280
Laminated dark and gray, sandy and stony, shale, showing mica and and shreds of vegetation, very much comminuted	1,280	1,285
Like the preceding	1,285	1,290
Like the preceding	1,290	1,295
Like the preceding	1,295	1,300
Like the preceding	1,300	1,305
Like the preceding	1,305	1,310
Like the preceding	1,310	1,315
Like the preceding	1,315	1,320
Like the preceding	1,320	1,325
Like the preceding	1,325	1,330
Like the preceding	1,330	1,335
Like the preceding	1,335	1,340
Like the preceding	1,340	1,345
Black shale with pyrites and some sandstone	1,345	1,350
Coarse sand showing secondary enlargement of grains, with some black shale	1,350	1,355
Like the preceding	1,355	1,360
Like the preceding. Mechanical analysis of the sand gives results as follows:		

Diameter of grains in mm.	Percentage of total sample.
1— .5	5
.5— .25	10
.25—.125	80
.125	5

Like the preceding	1,360	1,365
Like the preceding	1,365	1,370
Gray sand, of somewhat finer texture than the preceding	1,370	1,375
Gray coarse sandstone and some black shale	1,375	1,380
Like the preceding	1,380	1,385
Like the preceding, but with finer sand	1,385	1,390
Coarse sand and some gray shale	1,390	1,395
Sand, white	1,395	1,400
Like the preceding	1,400	1,405
White sand. The mechanical analysis of this sample is about as below:		

Diameter of grains in mm.	Percentage of total sample.
1— .5	3
.5— .25	6
.25—.125	85
.125	6

White and black shale	1,410	1,415
Like the preceding	1,415	1,420
Like the preceding	1,420	1,425
Like the preceding	1,425	1,430
Like the preceding, laminated	1,430	1,435
Like the preceding	1,435	1,440
White sand	1,435	1,440
White sand	1,440	1,445

Description of samples from Gray well—Continued.

	Depth in feet. From.	To.
White sand. (A change in texture noted here)	1,450	1,455
Fine reddish sand	1,455	1,460
Fine gray sand	1,460	1,465
Fine yellow sand	1,465	1,470
Fine yellow sand	1,470	1,475
Fine yellow sand	1,475	1,480
White limestone with some sand	1,480	1,485
Like the preceding, with two minute crinoid stems	1,485	1,490
Yellowish organic limestone	1,490	1,495
White limestone, containing fragments of fossils, with a few fragments of chalcedonic chert and with much dark shale	1,495	1,500
Organic calcareous fragments with dark shale and coarse white sand	1,500	1,505
Like the preceding	1,505	1,510
Like the preceding	1,510	1,515
Dolomitic(?) limestone, with occasional purple tint, mixed with much shale and sand	1,515	1,520
Yellowish sandstone, with some shale, and dolomitic ? fragments	1,520	1,525
Like the preceding	1,525	1,530
Limestone, organic, fragmental gray, calcareous, with some shale and sand. Some shale is green	1,530	1,535
Like the preceding	1,535	1,540
Like the preceding	1,540	1,545
Dark gray, organic fragmental, limestone, with some green shale	1,545	1,550
Like the preceding, with more shale	1,550	1,555
Gray and greenish gray shale and gray calcareous limestone, with a fragment of a fossil shell	1,555	1,560
Gray calcareous, organic, limestone and greenish shale	1,560	1,565
Fine gray sand and shale with pyrite	1,565	1,570
Gray sandstone and shale	1,570	1,575
Dark gray shale, gray sandstone and limestone	1,575	1,580
Black shale, showing a few brown blotches	1,580	1,585
Black shale, with green and red shale, some limestone and pyrite	1,585	1,590
Dark green shale, with green, and some red shale and limestone	1,590	1,595
Like the preceding	1,595	1,600
Like the preceding, with two thin flakes of coal, and a few bits of red limestone	1,600	1,605
Dark gray and greenish gray shale, some white sandstone, and some red shale, with some fragments of limestone	1,605	1,610
Like the preceding, but more sandy. Pyrite	1,610	1,615
Gray fine sand, gray and black shale, limestone and pyrite	1,615	1,620
Gray fine sand and dark gray shale	1,620	1,625
Black and greenish shale with sandstone and pyrite	1,625	1,630
Black shale and gray sand	1,630	1,635
Black shale and gray sandy shale, with bits of red shale	1,635	1,640
Gray shale	1,640	1,645
Black shale, greenish shale and sandstone	1,645	1,650
Greenish gray shale and some white sand	1,650	1,655
Gray and green shale with sand. One fragment of pure black bitumen noted (burned when ignited)	1,655	1,660
Black and gray shale and sand, in about equal quantities	1,660	1,665
Slickensided, greenish gray shale and fine sand	1,665	1,670
Sandstone and dark shale	1,670	1,675
Sandstone, dark shale, and some limestone	1,675	1,680
Like the preceding	1,680	1,685
Gray fine sand	1,685	1,690
Like the preceding	1,690	1,695
Sand and dark shale	1,695	1,670
White limestone, effervescing slowly, dark gray shale and sand	1,700	1,705
Like the preceding	1,705	1,710
Fine yellow sand	1,710	1,715
Fine gray sand	1,715	1,720
Fine gray sand	1,720	1,725
Fine gray sand	1,725	1,730
Like the preceding	1,730	1,735
Like the preceding	1,735	1,740
Black and dark gray shale	1,740	1,745
Like the preceding	1,745	1,750
Dark gray shale and some gray limestone, with oolitic grains	1,750	1,755
Like the preceding	1,755	1,760
Grayish, white, fine, sand	1,760	1,765
Grayish white sand and some shale, effervescing slowly	1,765	1,770
Like the preceding	1,770	1,775
Dark gray and black shale, with some sand	1,775	1,780
Calcareous limestone with slow effervescence, and dark gray and red shale with oolitic grains, .5 mm. to .25 mm. in diameter	1,780	1,785
Gray calcareous limestone with bits of brachiopod shells, spines, occasional oolitic grains, and dark gray and dull red shale. Oolitic frequently oval	1,785	1,790
Like the preceding	1,790	1,795
Like the preceding, with more sand and more oolitic grains	1,795	1,800
Dark shale, some oolitic limestone	1,800	1,805

Description of samples from Gray well—Concluded.

	Depth in feet. From.	To.
Dark shale, oolitic limestone and some red shale	1,805	1,810
Dark shale, red shale, oolitic limestone and "lobster" red limestone	1,810	1,815
Like the preceding, but with less limestone	1,815	1,820
Like the preceding	1,820	1,825
Dark greenish gray shale, and dark red shale, with limestone, organic	1,825	1,830
Like the preceding, with a few limestone fragments of "lobster" red color	1,830	1,835
Dark gray, gray and red shale with organic limestone, with slow effervescence	1,835	1,840
Like the preceding	1,840	1,845
Like the preceding	1,845	1,850
Like the preceding	1,850	1,855
Oolitic limestone, effervescing slowly, and black and red shale	1,855	1,860
Like the preceding	1,860	1,865
Oolitic white calcareous limestone	1,865	1,870
Like the preceding	1,870	1,875
Like the preceding	1,875	1,880
Like the preceding	1,880	1,885
Like the preceding	1,885	1,890
Gray limestone effervescing slowly	1,890	1,895
Fine gray sand, pure, grains measuring about 1/6 mm. in diameter	1,895	1,900
Gray limestone, effervescing slowly with acid	1,895	1,900
Gray limestone, calcareous	1,900	1,905
Like the preceding	1,905	1,910
Like the preceding	1,910	1,915
Like the preceding	1,915	1,920
Like the preceding	1,920	1,925
Like the preceding	1,925	1,930
Like the preceding	1,930	1,935
Like the preceding	1,935	1,940
Gray calcareous limestone with a few bits of chalcedonic chert	1,940	1,945
Gray limestone, with slow effervescence, and some fragments of chert	1,945	1,950
Gray oolitic, calcareous, limestone	1,950	1,955
Like the preceding	1,955	1,960
Like the preceding	1,960	1,965
Gray oolitic limestone, effervescing slowly. Fragments of ribbed lamellibranch shell noted	1,965	1,970
Gray oolitic, limestone, effervescing slowly	1,970	1,975
Gray marl	1,975	1,980
Gray marl and some limestone	1,980	1,985
Gray, very finely granular, dolomitic, and oolitic limestone, with some chalcedonic chert	1,985	1,990
Like the preceding	1,990	1,995
Like the preceding	1,995	2,000

NOTE.—The Chester begins at 1,450 feet below the curb of this well.

42. WELL NO. 7, ON FARM OF W. H. SNYDER, DENNISON TOWNSHIP, LAWRENCE COUNTY.

This well of the Ohio Oil Company, on the farm of Willis H. Snyder, is situated in the SW. ¼ NW. ¼ sec. 25, T. 3 N., R. 12 W., Dennison Township, Lawrence County. Its elevation is 495 feet. Its section is in Pennsylvanian to a depth of 1,535 feet and in Mississippian below this. The Pottsville lies between 1,000 feet and 1,535 feet, and coal No. 6 is between 560 feet and 580 feet.

Description of samples from Snyder well.

	Depth in feet. From.	To.
Loess	1	5
Loess, silty	5	20
Gray sandy limestone and micaceous and calcareous sand. Spherules of pyrite noted, measuring from .25 mm. to 1 mm. in diameter	20	25
Micaceous gray sandstone with occasional shreds of carbonaceous material	25	35
Sandy shale	35	40
Gray shale	40	45

Description of samples from Snyder well—Continued.

	Depth in feet. From.	To.
Gray sandstone, coal, black shale, and pieces of gray limestone, crinoid stems, one crinoid plate from a calyx, and an umbo of a small brachiopod	45	50
Light gray shale of fine texture. No effervescense	50	55
Gray calcareous and sandy rock, with much concretionary calcareous material. One large fragment is black concretionary limestone with embedded minute white shells and tubes, apparently small gasteropods or foraminifera	55	60
Shaly sandstone, some shale, white and yellow limestone of concretionary appearance, and some coal	60	65
Sandy shale of very light gray color	65	70
Dark gray micaceous shale	70	90
Dark shale and black shale, fragments of concretionary limestone *Nucula beyrichi* (?), crinoid stems, tubes of *Ammodiscus*, and fragments of concretionary limestone	90	100
Black shale	100	105
Black shale, black calcareous "clod," occasional pieces of coal, crinoid stems, "mineral charcoal" showing woody structure, pyrite and calcite	105	110
Gray sandy micaceous shale	110	120
Gray micaceous sandstone	120	140
Gray sandy shale, black shale and coal, with some calcareous material	140	145
Gray sandy and micaceous shale	145	155
Fine gray sand	155	165
Fine gray shaly sand	165	170
Fine gray shaly sand, with dark shaly laminae	170	175
Laminated shaly sandstone	175	180
Laminated gray sandy shale	180	185
Dark micaceous and sandy shale	185	195
Dark shale, micaceous	195	200
Sandy shale and sandstone	200	205
Coarse, micaceous gray sand	205	215
Micaceous gray shale	215	225
Dark shale of fine texture	225	230
Dark shale, black shale, some sandstone, impure coal, and fragments of limestone, yellow. Crinoid stems and a small gasteropod noted	230	235
Fire clay, sandy shale, and concretionary fossil-bearing yellow limestone. A few fragments of coal noted	235	240
Gray shale	240	245
Gray stony shale	245	250
Dark micaceous shale	250	255
Gray micaceous shale	255	260
Dark micaceous shale	260	265
Gray shaly sandstone and sandy shale	265	270
Gray micaceous sand of fine texture	270	310
Gray sand and some lumps of light fire clay or shale containing imprints of leaves	310	315
Clean and white micaceous sand	315	320
Gray micaceous sandstone	320	335
Light gray fire clay, coal, some sandstone, and a little limestone. Minute spherules of siderite present in the fire clay	335	340
Cream white limestone of fine granular homogeneous texture, with occasional minute green specks, and occasional indistinct organic fragments	340	345
White limestone of fine uniform texture. Some fragments show a fine reticulate structure. Some greenish shale and pyrite	345	350
Brownish-red marly clay and limestone	350	355
Red marl, greenish marl, and white limestone	355	360
White limestone of fine uniform texture, with a few fragments of gray shaly limestone	360	365
Gray sandstone, biotitic and impregnated with irregular kernels and layers of yellow calcareous material	365	370
Some sandstone, some white limestone, and some fragments of a slowly effervescing material	370	375
Dirty dark marl and limestone, with some fragments of bright red marl, and some black fragments	375	380
Gray sandstone	380	385
Very dark shaly sandstone, bituminous green shale	385	390
Dark, almost black, sandy micaceous shale	390	400
Dark gray shale of fine texture	400	405
Gray micaceous shaly sandstone and some white limestone	410	415
Dark gray shale of fine texture. Coal	405	410
Dark gray shale of fine texture and some white limestone	415	425
Gray micaceous laminated sandstone	425	430
Dark gray shale and some brown clay	430	435
Dark gray sandstone with layers of siderite	435	440
Dark gray micaceous shale, and dark gray sandstone with layers of siderite	440	445
Dark gray micaceous shale, a dark gray sandstone with layers of carbonate of lime, and a few fragments of limestone	445	450
Dark gray shale, siderite and pyrite	450	455
Dark gray shale of fine texture and some siderite	455	460

Description of samples from Snyder well—Continued.

	Depth in feet. From.	To.
Dark gray micaceous shale, and gray sandstone with layers of siderite	460	470
Dark gray shale, sandstone and concretions of siderite	470	475
Dark gray shale of fine texture and some siderite	475	480
Dark gray micaceous shale, and some siderite	480	485
Dark gray shale, dark micaceous shale, and siderite	485	495
Dark gray shale, white and dark limestone	495	500
Siderite concretions showing cracks filled with calcite, and gray limestone and shale	500	505
Gray shaly sandstone, siderite concretions and some gray limestone	505	510
Gray shaly sandstone, fragments of white and gray limestone	510	515
Gray sandy shale, siderite and fragments of gray limestone	515	520
Dark gray shale, some greenish shale, siderite, and fragments of gray limestone	520	525
Dark gray micaceous shale, and some siderite	525	530
Dark gray shale, some greenish shale and some siderite	530	535
Dark shale, siderite and some brown limestone	535	540
Dark shale, siderite, fragments of limestone, and a part of a crinoid stem noted	540	545
Dark shale and fragments of limestone	545	560
Black shale with organic calcareous fragments. Crinoid stems and *Rhombopora lepidodendroides* noted. Spherules of siderite present. Spines of *Productus* (?)	560	565
Black shale with organic calcareous material, limestone, fragments of gray micaceous sandstone, numerous crinoid stems noted, also siderite. *Hustedia, Chonetes punctatus, Rhombopora lepidodendroides,* gasteropods and crinoid stems noted; also spines of productus (?)	565	570
Black shale with calcareous material, fragments of limestone and sandstone, small gasteropods, numerous crinoid stems, and spines of *Producti* noted	570	575
Coal, gray shale, limestone, numerous crinoid stems and pyrite	575	580
Brownish dark limestone, gray shale, and fragments of coal. Considerable pyrite, fossil wood in fragments	580	585
Brownish dark limestone, gray shale, some crinoid stems and *Chonetes* noted	585	590
Gray micaceous shale, gray shale, gray limestone and brown limestone	590	595
Gray sandy shale, fragments of brown and gray limestone	595	600
Dark gray shale of a fine texture and some pyrite	600	605
Dark gray shale of a fine texture, some gray micaceous shale, pyrite and fragments of coal	605	610
Dark gray shale of a fine texture	610	620
Dark gray micaceous shale	620	625
Dark gray shale and fragments of limestone	625	630
Dark gray micaceous shale and some pyrite	630	635
Dark gray shale, fragments of coal and limestone	635	640
Dark gray shale, fragments of limestone and some pyrite	640	645
Light gray sandstone of fine texture, and fragments of black shale	645	650
Light gray sandstone, and some fragments of black shale	650	660
Dark gray shale and light gray sandstone	660	665
Light gray micaceous fine sand	665	680
Fine white micaceous sand with infiltrated calcite	680	685
Fine white micaceous sand and some dark gray shale	685	695
Fine gray micaceous sand with infiltrated lime	695	700
Dark gray shale and gray sandstone	700	705
Gray micaceous laminated sandstone	705	710
Coal, some gray shale, and a few fragments of limestone	710	715
Gray micaceous laminated sandstone and some coal	715	720
Micaceous sandstone	720	725
Dark gray shale	725	730
Black shale of fine texture	730	735
Very dark stony shale of fine texture	735	740
Gray micaceous sandstone, some black shale and fragments of white limestone	740	745
Gray micaceous sandstone, soft, and containing calcareous material	745	750
Micaceous sandstone	750	755
Dark shale, sandstone, coal, with some limestone fragments	755	760
Fire clay, black shale, coal, sandstone, a few fragments of limestone, yellow siderite, spherical concretions, measuring from .125 mm. to 2 mm. in diameter	760	770
Dark shaly clay and micaceous clay, with coal, sandstone and small spherical concretions of siderite	770	775
Dark clayey shale and some micaceous and sandy shale	775	780
Gray clayey shale of fine texture, with some stony and micaceous shale	780	790
Dark gray shale, in part sandy, in part of fine texture. Much pyrite, some pyritized wood and "mineral charcoal"	790	795
Light gray shale or fire clay	795	800
Light gray fire clay, white sandstone, coal, and some fragments of white and yellow limestone	800	805
Gray clay shale or fire clay, coal, and white sandstone	805	810
Fire clay, sandy gray shale, black shale, coal and brown siderite	810	815

Description of samples from Snyder well—Continued.

	Depth in feet. From.	To.
Soft gray micaceous sandstone, with thin carbonaceous laminae, black shale, brown siderite, pyrite and some fragments of fissured white limestone	815	820
Black shale containing calcareous organic fragments, and gray sandstone containing thin layers of shaly material, pyrite and spherules of gray lime measuring about .5 mm. in diameter	820	825
Dark shale and greenish gray sandy fire clay	825	830
Gray micaceous sandstone, fire clay and black shale with white limestone. Crinoid stems noted	830	840
Black shale and gray micaceous sandstone, brown siderite, white limestone and partly pyritized mineral charcoal	840	845
Gray micaceous sandstone, laminated, gray marly shale	845	850
Laminated dark shale and sandstone, with a few fragments of coal, apparently from a thin seam in rock	850	855
Gray sandstone and sandy shale, with black shale, impure coal and siderite	855	860
Like the preceding but with some pure coal	860	865
Gray shale, fire clay, gray sandstone, and coaly black shale	865	870
Fire clay, gray shale, coal, brown siderite, white limestone, fragments of shells and crinoid stems, pyrite giving an oily film on the water when washed	870	875
Gray clayey shale, and coal, with some calcareous material	875	880
Like the preceding. Crinoid joints noted	880	885
Gray clayey shale, containing fragments of coal and of limestone and also some mica	885	900
Mostly fire clay, greenish gray, some gray sandstone, black shale, a little coal, and much pyrite. Fragments of shells and of limestone noted. In the fire clay a joint was filled with a thin film of black bituminous or carbonaceous material	900	905
Gray laminated micaceous sandstone	905	915
Dark gray sandy and micaceous shale	915	920
Gray micaceous sandstone and dark shale	920	925
Gray sandstone, greenish fire clay and coaly black laminated shale	925	930
Gray laminated sandstone, black shale, brown siderite, fragments of white limestone	930	935
Sandstone, from dark to light gray, and showing streaks of carbonaceous material, together with black coaly shale	935	940
Greenish gray fire clay, containing spherules of siderite from .25 mm. to .5 mm. in diameter, and having thin joints filled with bituminous or carbonaceous material. Some sandstone and shale	940	945
Greenish gray fire clay	945	950
Dark shale of fine texture	950	955
Gray coarse sand with a faint odor of petroleum. It floats on water	955	960
Black and dark shale, with some carbonaceous layers	960	965
Dark and black shale and concretionary siderite and white limestone	965	970
Minutely blotched and light gray limestone	970	975
Minutely blotched dark gray limestone and some dark shale	975	980
Dark clayey shale	980	990
Black shale and gray sandstone	990	995
Black coaly shale with brownish streak and containing streaks of brown flaky siderite, greenish gray fire clay, gray limestone, and stony fire clay filled with minute spherules of siderite	995	1,000
Black and gray shale and a fragment of coal	1,000	1,005
Coarse quartz sandstone with fragments of siderite	1,005	1,010
Gray sandstone with siderite grains	1,010	1,015
Gray sandstone with many grains of brown siderite	1,015	1,020
Fairly coarse gray sand	1,020	1,030
Fine gray sand having the odor of petroleum	1,030	1,035
Fine gray sand with some black and gray shale, white limestone, and yellow and brown siderite	1,035	1,040
Gray sandstone, some coarse with black and brown grains, some laminated, alternating with black micaceous shale	1,040	1,045
Black shale, some sandstone, and some white limestone	1,045	1,050
Black stiff shale, some clayey shale and white limestone	1,050	1,060
Black shale and fire clay with a few fragments of coal	1,060	1,065
Black shale and some white limestone	1,065	1,075
Black shale, some pyrite and white limestone	1,075	1,080
Black shale and some pyrite	1,080	1,085
Gray sandstone with embedded siderite spherules and shreds of carbonaceous material	1,085	1,090
Gray sandstone of fine texture	1,090	1,100
Gray sandstone of fine texture with some dark gray shale	1,100	1,105
Gray sandstone of fine texture	1,105	1,110
Gray sandstone with some fragments of white limestone	1,110	1,115
Laminated shaly sandstone, consisting of layers of dark sandy shale and light gray sandstone	1,115	1,120
Laminated sandstone and shale	1,120	1,130
Green and black fire clay of fine texture, cut by joints	1,130	1,140
Greenish blotchy very dark fire clay, with siderite concretions in large fragments, and some very red clay lumps with green cores	1,140	1,145

Description of samples from Snyder well—Continued.

	Depth in feet. From.	To.
Very dark, almost black fire clay	1,145	1,150
Very dark, almost black fire clay, of a greenish tinge, some bright red clay showing green streaks, some white limestone, and some coal or bituminous substance	1,150	1,155
Very dark fire clay	1,155	1,160
Dark fire clay-like shale	1,160	1,165
Black stiff shale and fragments of siderite concretions	1,165	1,170
Black shale and dark green shale	1,170	1,185
Black shale and gray shale, with some white sandstone and fragments of siderite concretions	1,185	1,190
Black shale	1,190	1,195
Black shale with some fragments of siderite	1,195	1,200
Dark gray shale of fine clay-like texture	1,200	1,205
Laminated white and black sandstone. The laminae are thin	1,205	1,215
Dark shale	1,215	1,220
Dark shale with some sandstone	1,220	1,225
Dark shale	1,225	1,235
Dark sandy shale and laminated sandstone	1,235	1,240
Dark shale	1,240	1,245
Dark sandy shale and white, fine-grained sandstone, apparently interlaminated. Also some fragments of white limestone	1,245	1,255
Gray shale, greenish fire clay, some coal and a little nodular limestone	1,255	1,260
Gray shale and dark shale, some yellow siderite, some white limestone and a few fragments of coal. Bituminous joints	1,260	1,270
Gray shale, black shale, white sandstone of fine texture and white limestone	1,270	1,280
Gray shale, considerable white limestone, and white sandstone of fine compact texture	1,280	1,285
Black shale and white fine-grained sandstone with some limestone	1,285	1,290
Fine-grained, hard white sandstone, gray, sandy shale and white limestone	1,290	1,295
Micaceous gray sandstone, black shale and some pieces of white limestone	1,295	1,300
Dark gray shale, white fine-grained sandstone, and some fragments of white limestone	1,300	1,305
Light gray micaceous sandstone, gray shale and some fragments of white limestone	1,305	1,310
Dark gray shale, laminated sandstone and some limestone	1,310	1,315
White, fine-grained sandstone, gray shale, white limestone, and some pyrite	1,315	1,320
Sand, fairly coarse	1,320	1,325
Yellow rusty sand	1,325	1,340
Yellow rusty sand with some shale	1,340	1,345
Laminated gray sandstone of fine texture	1,345	1,355
Fine sand with some shale and calcareous material	1,355	1,360
Fine sand and shale with some carbonate of lime	1,360	1,365
Fine sand and shale	1,365	1,370
Dark gray shale and sand	1,370	1,380
Sand, gray shale and black shale	1,380	1,405
Greenish gray fire clay, some dark shale, considerable pyrite, and sand (from above)	1,405	1,410
Greenish gray fire clay, much pyrite, a few fragments of rock containing organic calcareous fragments and some sand	1,410	1,415
Dark greenish gray shale, some fragments of black shale, and pyrite	1,415	1,420
Sand of fine texture and dark greenish gray shale or fire clay with much pyrite	1,420	1,425
Dark green fire clay or shale, very much pyrite and fragments of coal, evidently from a thin seam	1,425	1,430
Dark greenish gray fire clay, pyrite and fragments of impure coal	1,430	1,435
Dark green fire clay and dark shale with some coal	1,435	1,440
Very dark shale, thin splitting and dark green fire clay	1,440	1,445
Very dark shale, dark green fire clay, a little coal and pyrite	1,445	1,470
Dark green fire clay and dark shale, pyritiferous	1,470	1,480
Dark green fire clay-like shale	1,480	1,495
Dark green fire clay-like shale, with much pyrite, and some coal in thin seams	1,495	1,500
Dark green fire clay-like shale	1,500	1,510
Dark green fire clay-like shale, some black bituminous shale with thin laminae of coal, and with pyrite	1,510	1,515
Dark green fire clay-like shale, dark gray shale, with pyrites, like shale of "Coal Measures"	1,515	1,520
Dark green fire clay, like shale, and dark gray shale with pyrite	1,520	1,535
Brownish red marl, some fire clay-like greenish shale, some pyrite and some fragments of white limestone. The red marl and the limestone have the aspect of the Chester	1,535	1,540
Brownish red shale, pyrite and fragments of white limestone	1,540	1,545
Red marly shale, gray marly shale and white limestone	1,545	1,565
Dark gray shale and marl	1,565	1,570

Description of samples from Snyder well—Concluded.

	Depth in feet. From.	To.
Dark gray stony marl and fragments of white limestone, with crinoid stems	1,570	1,590
Gray marl and red marly shale with fragments of white limestone	1,590	1,595
Gray, green and red shale, white limestone, sandy limestone, pyrite and crinoid stems	1,595	1,615
Greenish gray calcareous shale	1,615	1,635
Dark green, stony, calcareous shale	1,635	1,640
Dark gray shale, organic fragmental limestone, dirty speckled, gray	1,640	1,645
Shale and limestone	1,645	1,650
Gray marly shale and organic fragmental limestone. Oily	1,650	1,655
Organic fragmental limestone and some shale. Oily	1,655	1,660
Dark gray shale, green shale, red shale and organic fragmental limestone. Oily	1,660	1,665
Like the preceding with less limestone	1,665	1,680
Red marly shale and green laminated shale	1,680	1,685
Red marly shale and dark green shale	1,685	1,695
Gray marly shale, gray sandstone of fine texture and some organic fragmental limestone	1,695	1,700
Gray marly shale	1,700	1,730
Fine gray quartz sand showing a few mica scales	1,730	1,755
Fine textured gray sand with some shale	1,755	1,760
Fine textured gray sand with some gray shale	1,760	1,765
Gray marly shale and sand	1,765	1,775
Fine textured gray sand, dark gray shale, with some fragments of limestone showing joints filled with black bituminous films	1,775	1,780
Gray marly shale and fine sand	1,780	1,785
Earthy black marly shale filled with bitumen	1,785	1,795
Partly like the preceding, partly gray stony marl	1,795	1,800
Gray marly shale and fine sand	1,800	1,805
Like the preceding with some very thin-splitting black shale	1,805	1,810
Black shale and fine gray sand	1,810	1,920
Gray marly shale, and some black bituminous material, shining on conchoidally fracturing surfaces. Fractures and fuses in flame	1,820	1,825
Gray marly shale	1,825	1,830
Gray marly shale, with a black bitumen showing conchoidal, shiny cleavage	1,830	1,835
Gray marly shale with a few small fragments of bitumen	1,835	1,840
Gray marly shale	1,840	1,850
Gray marly shale, with some fine micaceous sand, and showing black streaks	1,850	1,860
Gray marly shale	1,860	1,865
Almost black and dark, greenish-gray, marly, sandy shale, showing red streaks, and a dark greenish sand of fine texture. Mica noted. Oily	1,865	1,880
Dark, greenish gray fire clay-like shale. Oily	1,880	1,885
Dark, greenish gray shale and sandy rock, and some red shale appearing earthy, from bitumen	1,885	1,890
Green and red shale, with some fragments of sandstone and some organic limestone. Oily	1,890	1,910
Oolitic limestone and green shale	1,910	1,915
Oolitic limestone, other limestone, green shale and some red shale. A small *Dielasma* noted. The dark green shale splits into very thin fragments	1,915	1,920
Green shale, dark shale, red shale, and oolitic limestone	1,920	1,930
Green shale, red shale, and some dirty looking limestone and oolite. Crinoid stem noted	1,930	1,945
Mostly iron rust from bit or casing	1,945	1,950
Limestone with a great deal of rust	1,950	1,955
Granular limestone with some well rounded quartz sand, and some oolitic grains	1,955	1,960
Granular limestone, gray	1,960	1,965
Coarse oolitic limestone, with some quartz grains	1,965	1,970
An organic breccia, with embedded oolitic grains, and some quartz grains	1,970	1,980
Organic fragmental limestone, with oolitic spherules, and with a few fragments of chert	1,980	1,995
Limestone, fragmental, oolitic	1,995	2,000

The writer's interpretation of this section is as below:

	Feet below surface.
Coal No. 6, probably at	560- 580
Pennsylvanian	0-1,000
Pottsville (Pennsylvanian)	1,000-1,535
Mississippian	1,535-2,000

43. WELL NO. 1, ON FARM OF E. J. RIDGELY, DENNISON TOWNSHIP, LAWRENCE COUNTY.

Well No. 1, on the farm of E. J. Ridgely is operated by the Ohio Oil Company. It is situated in the NE. ¼ sec. 11, Dennison Township, Lawrence County. Its curb is elevated 471 feet above sea level. Its entire section is believed to be in the Pennsylvanian with coal No. 6 at a depth of about 800 feet.

Description of samples from Ridgely well.

	Depth in feet. From.	To.
Loess	0	6
Loess	6	12
Loess, with some sand	12	18
Loess	18	24
Loess, with some sand	24	30
Drift, a yellow silt with some sand	30	36
Like the preceding, body more sandy	36	42
A yellow, sandy silt	42	48
Like the preceding	48	54
Yellow sandy silt	54	60
Yellow sand, slightly micaceous	60	66
Gray sand	66	72
Gray sand, with some mica	72	78
Like the preceding	78	84
Gray sand, in part crushed	84	90
Like the preceding	90	95
Gray sand	95	100
Gray sand	100	105
Gray sand	105	110
Black shale, coaly, thinly laminated, with some black calcareous, concretionary fragments	110	115
Dove-colored shale, of fine texture	115	120
Like the preceding (4 samples)	120	140
Dove-colored shale, silty	140	145
Like the preceding (5 samples)	145	170
Light gray shale, of fine texture	170	175
Like the preceding	175	180
Dove-colored shale, silty (3 samples)	180	195
Some gray shale and some black coaly shale	195	200
Dark gray, soft shale	200	205
Gray, soft, shale	205	210
Like the preceding (2 samples)	210	220
Dove-colored shale, silty	220	225
Gray, fine-grained sand	225	230
Light gray silty shale and some carbonaceous shale	230	235
Greenish gray fire clay	235	240
Greenish gray sandy shale	240	245
Gray micaceous sand, with some black shale	245	250
Gray micaceous sand, with some black carbonaceous shale and some fragments of clay ironstone	250	255
Like the preceding (2 samples)	255	265
Mostly a white limestone of a peculiar minute reticulate texture, also showing some minute organic structures	265	270
Like the preceding, with some fragments of a dark limestone	270	276
Limestone like that in the two preceding samples, with some gray sandstone and some shale or fire clay	276	282
White limestone	282	288
White limestone and gray marly shale	288	294
Bluish gray shale of fine texture	294	300
Gray limestone, concretionary(?), and gray shale	300	306
Light gray shale	306	312
Like the preceding (2 samples)	312	324
Gray shale	324	330
Gray shale	330	336
Gray silty shale	336	342
Gray shale	342	348
Gray silty shale (2 samples)	348	360
Gray sandy shale	360	366
Very fine-textured, gray sand, and some green shale	366	372
Like the preceding, but darker	372	378
Gray shale (7 samples)	378	420
Gray shale and coal	420	426
Fire clay and coal	426	432
Gray shale	432	438

Description of samples from Ridgely well—Continued.

	Depth in feet. From.	To.
Shale, gray, stiff, micaceous	438	444
Gray shale, white limestone and coal	444	450
Gray shale, with some sand and limestone	450	456
Black limestone	456	462
Gray shale, with some limestone and coal	462	468
Gray shale, in part sandy, and some dark limestone, which effervesces slowly on the application of acid	468	474
Greenish gray shale, with some black shale	474	480
Shale, some dark gray and micaceous, some sandy	480	486
Dark sandy shale, earthy in appearance, with some fragments of limestone, in which fragments of fossils were noted	486	492
Gray silty shale	492	498
Black shale	498	504
Black shale of fine texture, blotched	504	510
Dark shale, sandy, micaceous, and with imbedded fragments of carbonaceous material	510	516
Black shale of fine texture, and some coal	516	522
Dark fire clay and some coal	522	528
Light gray shale	528	534
Light gray shale, micaceous and marly (3 samples)	534	552
Light gray shale, micaceous, silty	552	558
Like the preceding	558	564
Gray shale, silty and micaceous	564	570
Some greenish gray shale, silty and sandy, with shreds of vegetation. A leaf-like impression shows a reticulate structure	570	576
Greenish gray shale or fire clay, with shreds of carbonaceous material	576	583
Gray micaceous shale	583	590
Dark gray shale (2 samples)	590	604
Gray shale, with some limestone, some black carbonaceous shale and some fragments of clay ironstone. Some fragments of a white limestone were noted. This was brecciated and consisted of minute angular fragments separated by veins of clear calcite. There were also some fragments of a black limestone	604	611
Dark gray shale, with some black shale, and some white brecciated limestone. A protoconch of an *Orthoceras*	611	618
Gray micaceous shale and some compact gray limestone and much coaly black shale. Spherical concretions of siderite, ¼ mm. in diameter, were noted	618	625
Gray shale (2 samples)	625	639
Sandstone of fine texture, and sandy shale	639	646
Gray sandy shale, with concretionary spherules of clay ironstone. Also some yellow limestone	646	652
Gray, micaceous, sandy shale	652	658
Like the preceding (2 samples)	658	670
Micaceous sandy shale, and some greenish shale	670	676
Gray shale, black shale, and coal, with some fragments of clay ironstone concretions	676	682
Dark gray shale	682	687
Dark gray shale	687	692
Dark gray shale	692	698
Gray, micaceous, sandy shale, or shaly sandstone	698	706
Gray, micaceous shale, with pyrites. Also some limestone	706	710
Gray carbonaceous shale, with carbonaceous sandstone	710	715
Black shale, with some fragments of limestone and pyrite	715	720
Black shale	720	726
Black shale, gray micaceous sandstone, and pyrite	726	732
Like the preceding	732	738
Black shale and gray sandstone, with pyrite and siderite concretions	738	744
Coal, fire clay, and black shale	744	750
Greenish gray fire clay, with a few fragments of coal, black shale, sandstone, and pyrite	750	756
Light gray shale, with some coal and sandstone	756	762
Black fissile shale, gray shale, some coal and sandstone. The black shale has narrow light fucoid	762	768
Gray shale	768	774
Gray shale and gray sandstone	774	780
Shaly sandstone, light gray, micaceous	780	786
Like the preceding, with some dark shale	786	792
Black "miner's slate," coal, and limestone. The limestone is dark or black, with some white, like the limestone over number 6 coal. Some fragments of fossils were noted	792	798
A white siliceous rock, with minute black specks, scattered or lying in curving broken streaks. The rock contains occasional scales of mica. It recalls the texture of the "white cap" over the No. 6 coal in Peoria County. Sandstone, gray shale, black miner's slate, and coal were also noted. The limestone contained *Rhombopora lepidodendroides*	798	804
Gray stony shale, limestone, coal, and sandstone, as above. *Rhombopora lepidodendroides* noted	804	810

Description of samples from Ridgely well—Continued.

	Depth in feet. From.	To.
Limestone, sandstone, and shale. One crinoid joint, one Productus(?) spine, and one *Rhombopora lepidodendroides* was noted	810	816
Dark grayish yellow, impure limestone, frequently with yellow oolitic spherules less than .25 of a mm. in diameter, with some shale. Pyrite and a bryozoan noted in some black shale	816	822
Some dark and some light limestone, with much coal and some black shale. Pyrite noted	822	828
Dark gray micaceous shale	828	834
Like the preceding	834	846
Like the preceding, with some coal and a brownish gray limestone, in which *Rhombopora lepidodendroides* was noted	846	852
Gray unctuous clay and black shale	852	858
Greenish gray shale, with sandstone that is frequently filled with small oolitic spherules of carbonate of iron, which measure from .125 mm. to nearly 1 mm. in diameter, some fragments consisting entirely of these spherules, being an oolitic rock of carbonate of iron	858	864
Sandstone and shale	864	870
Sandstone and shale, showing thin foliations of alternately light and black shale	870	877
Like the preceding	877	884
Gray shale and sandstone, with white limestone and coal and also some "miner's slate." Pyrites, shreds of vegetation, and "mineral charcoal"	884	891
Gray and dark micaceous shale, with limestone and oolitic spherules of carbonate of iron	891	898
Gray, micaceous shale	898	904
White limestone, with organic fragments, and black and greenish shale and sandstone	904	910
Shale, sandstone and limestone	910	916
Gray shale, sandstone, and white limestone impregnated with bituminous material	916	922
Gray shale, and some red shale	922	928
Gray shale	928	934
Dark shale and fire clay	934	940
Dark gray shale	940	946
Black shale, some limestone and some coal	946	952
Shale and coal	952	958
Sand	958	964
Sand and some green shale	964	970
Gray and dark shale in thin alternate laminations	970	976
Sand and some shale	976	982
Dark gray shale	982	988
Sand and dark shale	988	994
Dark gray micaceous shale and sand, with pyrite having vegetable structure	994	1,000
Gray dark shale	1,000	1,006
Dark gray shale	1,006	1,012
Sand and dark micaceous shale, with concretionary siderite and pyrite	1,012	1,018
Dark shale	1,018	1,024
Hard dark shale	1,024	1,030
White sand	1,030	1,036
Light gray micaceous sand	1,036	1,042
Yellowish gray, micaceous sand	1,042	1,048
Like the preceding	1,048	1,054
Like the preceding	1,054	1,060
Black and gray shale, with thin laminations	1,060	1,066
Dark shale of fine texture	1,066	1,072
Black shale of fine texture	1,072	1,078
Micaceous sand, yellowish white	1,078	1,084
Shale and clay, some dark and some greenish gray	1,084	1,090
Sandstone, with much carbonaceous material, and some shale	1,090	1,096
Dark shale	1,096	1,102
Sand and shale	1,102	1,108
Sandstone of somewhat coarse texture, with some shale	1,108	1,114
Sandy shale, sand and fire clay	1,114	1,120
Sand	1,120	1,126
Sand	1,126	1,132
Dark gray stony shale, with some shale and sandstone	1,132	1,138
Sand, with some shale	1,138	1,150
Dark shale, with some sand, some pyrite and some manganese concretions, such as have been noted in fire clays	1,150	1,156
Black shale with some bony coal	1,156	1,162
Like the preceding	1,162	1,168
Stony, black laminated shale	1,168	1,174
Gray sand	1,174	1,180
Gray sand	1,180	1,186
Black shale, limestone and coal	1,186	1,192
Greenish gray fire clay	1,192	1,198
Black shale and sandstone	1,198	1,204
Yellowish gray sand; floats on water	1,204	1,209

Description of samples from Ridgely well—Concluded.

	Depth in feet. From.	To.
Like the preceding	1,209	1,214
Black shale	1,214	1,219
Laminated black shale	1,219	1,224
Black and gray shale, with some coal	1,224	1,229
Like the preceding	1,229	1,234
Sand, floats on water	1,234	1,239
Sand, dark brown, oily	1,239	1,244

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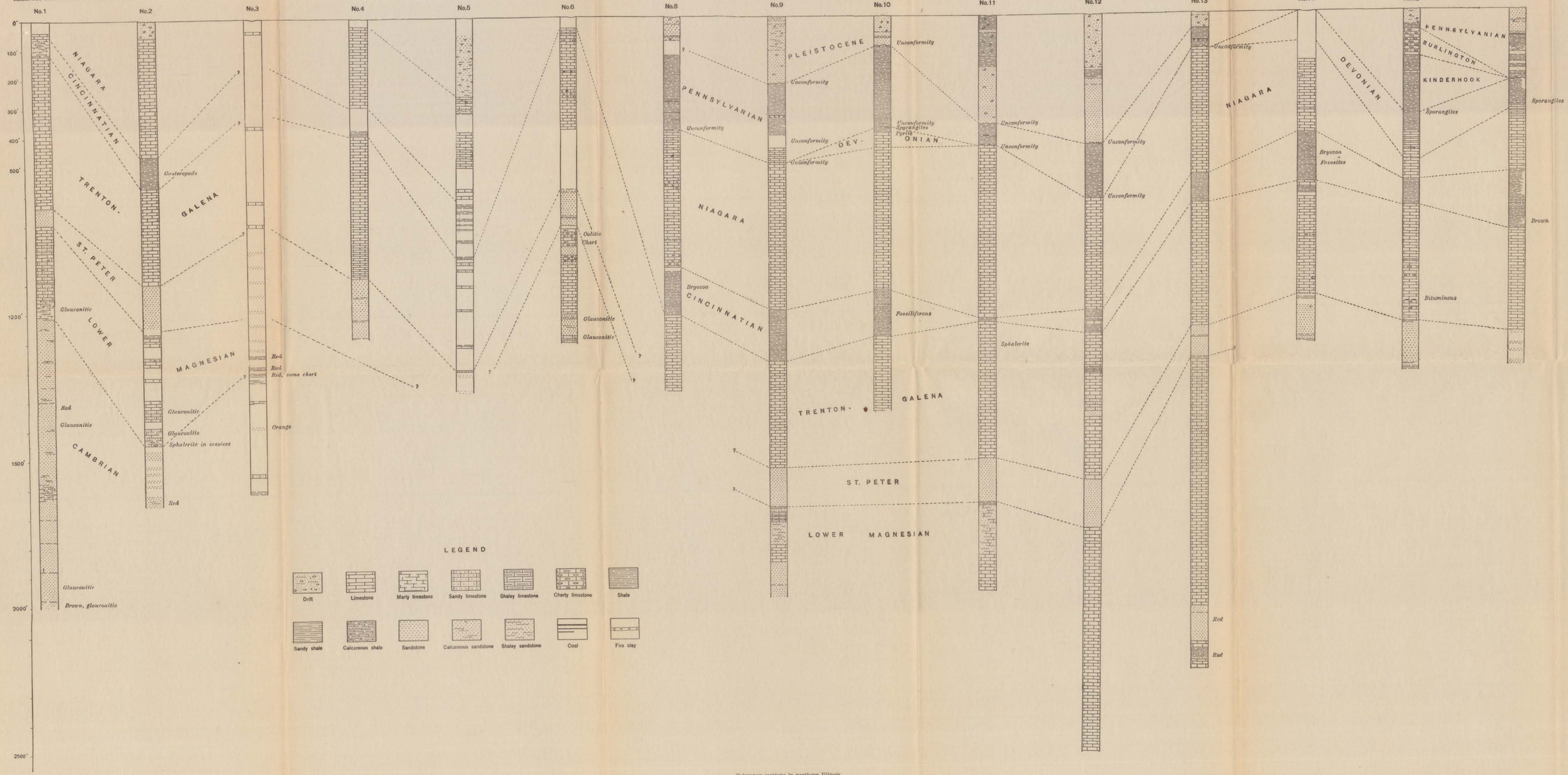
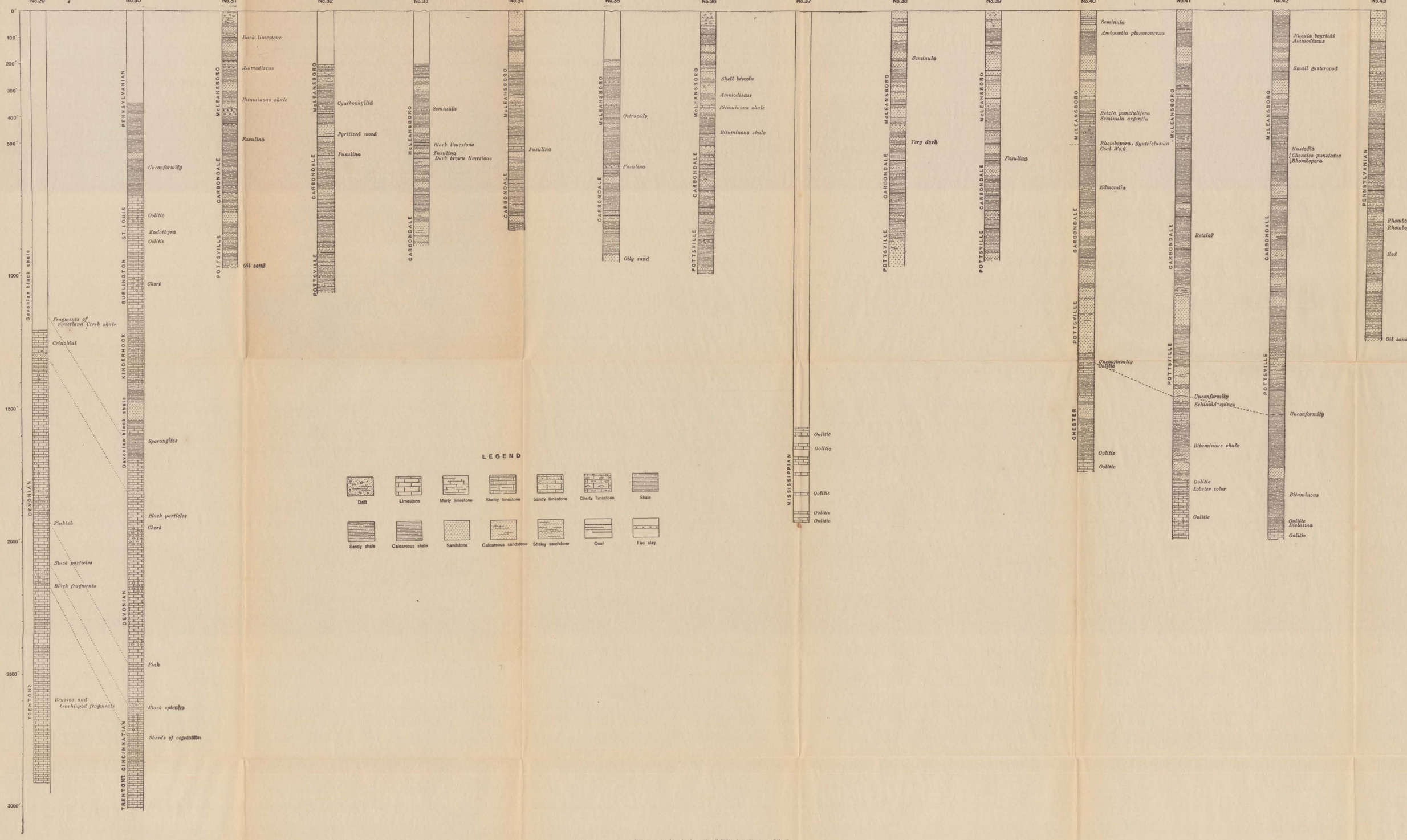


Columnar sections in northern Illinois.

Columnav sections of ceral and southern Illinois



Columnav sections in the main oil field of southeastern Illinois